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DECEMBER 1959

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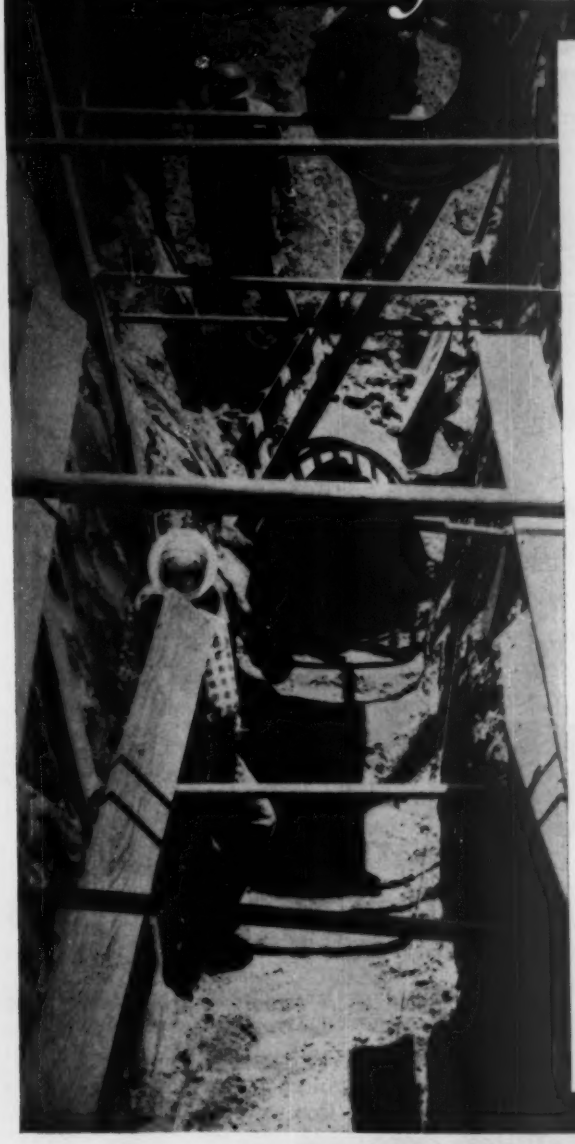

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Managing Editor

V. W. LANGWORTHY
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J. R. Baylis — R. C. Merz
P. D. Haney — A. M. Rawn
C. E. Keefer — R. W. Simpson
C. F. Gurnham — W. A. Cawley

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CHICAGO OFFICE: 185 N. Wabash Av.
E. S. Gillette, Publisher
H. J. Conway, Adv. Ed.
F. C. Maurer, Managing Editor
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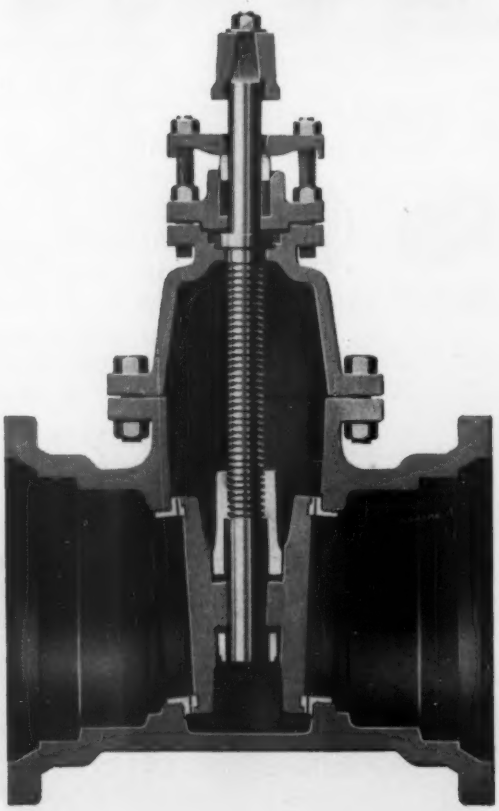

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Briefs

Explosive Suburban growth expanded a one-hundred acre sanitation district outside of Denver into an eight square mile water and sanitation district with a 4 mgd softening plant and treating both domestic sewage and industrial wastes. For how this situation developed and how the district coped with the problems—Page 505.

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Silica Sols in Water Treatment have proven to be a valuable tool in water coagulation. This article reviews applicability, methods of preparation and actuation—Page 541.

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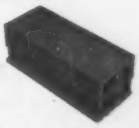

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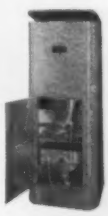

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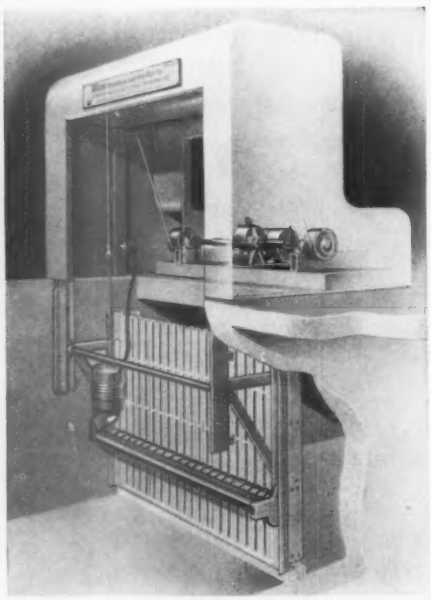

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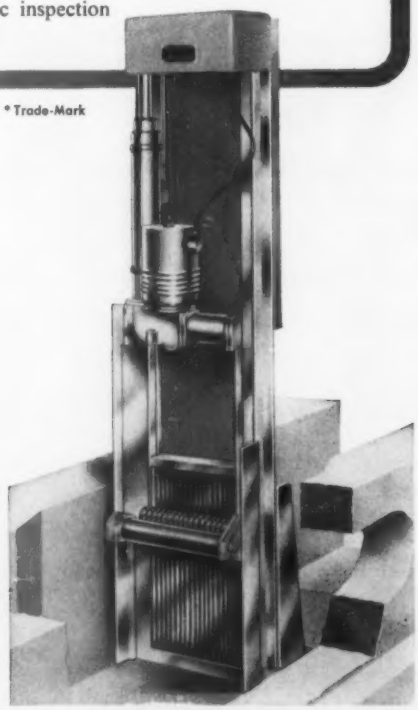

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News—Here & There

How To Use Chlorine

The Chlorine Institute, Inc., has recently published the third edition of its "Chlorine Manual". The new publication, considerably wider in scope than previous editions, is intended to be a compendium of the knowledge and experience, available to the Institute, of the materials, equipment and practices that contribute to the safe handling, storage, shipment, and uses of chlorine.

The important properties of chlorine are listed in the manual as well as practical methods of handling emergencies that might be encountered. An extensive bibliography is another feature of the publication.

An Addenda To A Previous Article

In the September issue of Water and Sewage Works, Mr. Don Bloodgood presented an article entitled, "Waste Water Treatment in England and Holland". Mr. J. McNicholas, General Manager of the Rivers Department, Manchester, England, has expressed the view that, to dispel a possible misunderstanding of the Manchester plant and its operation, further information might be published as an addenda to Mr. Bloodgood's article. These are the points Mr. McNicholas believes have particular interest.

The article had stated that three or four persons were observed to be working in the laboratory. Mr. McNicholas advises that a staff of six laboratory chemists is regularly employed, but that some of them were on vacation at the time of Mr. Bloodgood's visit.

In another part of the report, where Mr. Bloodgood discussed "High-Cone aeration units, it was stated: "They are apparently using a high concentration of solids in the aeration tank and must consequently be using a considerable amount of horsepower to get the required aeration." This comment was intended to disclose that, with mechanical aeration, it is possible to supply the air required for a mixed liquor with a solids concentration higher than generally believed possible in America.

Since horsepower is required to produce aeration, if the solids are high, the requirement for oxygen must also be high. It was the writer's intent to impress the American readers that the English were doing something not common here in America.

Mr. McNicholas has furnished information on the power requirements for several types of aeration units, and this data is shown in Table I. He has also provided some data on the operation of the "High Intensity Cone" unit operating at the Manchester plant. This data is shown in Table II.

Table I
Comparison Of Aeration Units
McNicholas Data

System	H.P./m.g.d.	lbs. B.O.D. removed per kW. hr.
Sheffield Bioaeration	37.4	3.05
Sheffield Bioaeration plus Kessner Brush	55.3	3.00
Diffused Air	46.4-53.1	2.25
Simplex Standard High Cone (40 r.p.m.)	35.1	3.27
Pasveer Brush Aeration	52.1	2.16
Kessener Brush Aeration	49.0-59.5	2.12-2.30

Table II
High Intensity Cone Aeration Unit
Manchester, England

Average daily volume treated	383,000 gallons
Average total H.P./m.g.d.	34.3
5-day B.O.D. of feed	216.7 p.p.m.
5-day B.O.D. of effluent	19.6 p.p.m.
Suspended solids of feed	97 p.p.m.
Suspended solids of effluent	24 p.p.m.
Sludge solids in mixed liquor	4,800 p.p.m.
Average aeration period	2.16 hours
lbs. B.O.D. removed/kW. hr.	3.21

Conference Studies Marine Environment

The first International Conference on Waste Disposal in the Marine Environment held earlier this year at Berkeley, California, attracted more than 300 engineers and scientists from 20 states and 14 foreign countries. Featured during the conference were half-day sessions which were devoted to public health, nearshore oceanography, effects on marine biota, receiving water analyses and estuarine hydrography.

The delegates who visited the U.S. Army Corps of Engineers, San Francisco Bay Model in Sausalito were treated to an unusual demonstration. The Corps staff staged a display of a "tracer release" in South San Francisco Bay, showing the flushing and dispersion characteristic using a visible dye.

Pennsylvania Discloses Improved Water Supplies

Governor Lawrence announced that Pennsylvania communities have been installing, on the average, one new water supply system a month for the past year and a half. He said that the twenty systems built since March of last year reflect the increasing demands for water for both domestic and industrial uses in the state.

In a report to the governor, State Sanitary Water Board Chairman Charles L. Wilbar, disclosed that more than 9,000,000 Pennsylvanians now depend on public water supplies. The report stated that they are served by 1,075 systems ranging from the smaller ones which serve as few as 100 persons to the Philadelphia water system which serves some 2,000,000 customers.

Of the 1,075 approved water works, 247 have filtration facilities, 589 provide chlorination and 239 are without treatment facilities. Those without treatment, Dr. Wilbar said, are generally located in remote sections of the state. The trend is toward chlorination of all public water supplies.

CONTINUED ON PAGE 9A

FLUIDICS* AT WORK

Checking clarified effluent of the Permutit Colloidair Separator at the Homasote Company

How to side-step a public health hazard ... and step into big new savings

Maybe you have a problem similar to the one that confronted the Homasote Company, Trenton, N. J.

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Saves product. White water feeds into the Colloidair, where a "bubbling-out" process raises the fibers to the surface. These fibers are scraped off and reclaimed.

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Saves heat. The reclaimed water holds most of its heat during the clarifying process. This saves the expense of re-heating for re-use.

Easy to use. Colloidair works almost by itself. The operator does little more than periodically charge chemical tanks.

Homasote is getting these benefits today . . . when would YOU like to start?

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Observing Colloidair's chemical feed at Homasote

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News—Here & There

CONTINUED FROM PAGE 7A

Foam Disposal Methods Tested

A recent experimentation investigated the relative merits of different methods of foam disposal following the surface stripping removal of ABS from sewage. One method tested involved the initial separation of induced froth from the aeration chamber prior to combustion, and combustion at the point of aeration.

In the latter method, burning at the surface of the liquid and also at a point above the liquid was tested. Results showed that surface burning was quite effective, and the method is still being tested to determine whether it is preferable to the separated-flame-chamber type of foam-disposal unit.

The investigation of the effect of ABS on sludge digestion has also shown that increased concentrations beyond that which normally occur in the digestor can cause a great deal of trouble to develop in the digestor.

Adjustable Dam Helps Save Water

The Los Angeles Department of Water and Power is continually faced with the problem of having either too much or too little a supply of water. Recently, in an effort to solve this problem, they constructed a temporary wooden dam across the Los Angeles River during the low water season. The purpose of the dam was to divert river water into nearby deep gallery spreading grounds instead of letting it flow out to sea. After the diverted water had filtered through the soil of the spreading grounds, thereby purifying itself, it was pumped out of an underground basin into the city's water distribution system.

This device almost worked. However, as soon as the winter flood conditions prevailed, the wooden dam would be washed out by one of the earliest storms. Thus there would be no barrier to divert water to the storage areas for future use. Not only did the malfunction of the dam discourage officials, but the cost of having to rebuild a new dam each year inspired them to seek a new and better water diversion technique.

After a great deal of study, the idea of a collapsible dam was developed and tested. This device is a permanent installation that collapses temporarily and lies flat on the river bottom during the flood season. Essentially, it is a flexible tubular dam that can be inflated with water to attain a predetermined height. Through the use of a siphoning arrangement, it can be gradually deflated as the weight of the river water passing over it increases during flood stages. When flood conditions subside, it is reinflated for operation as a dam and water diverter.

During the heavy rain and flood season of late 1957, the experimental dam was completed and was immediately subjected to many severe storms. It proved to be a complete success. Plans were then laid for the erection of a permanent collapsible dam and, early this Spring, the new dam was installed, tested, and put into regular operation. The Department estimates that about 2000 acre feet of water, valued at some $75,000, will be recovered through the use of the new dam. The cost of the dam, which was manufactured by a leading rubber firm, was $7,100, exclusive of installation which was performed by the Department's own work crews. It is possible that this new device will help solve similar problems vexing irrigation and flood control agencies.

Flood Control for Indianapolis

The Indiana Flood Control and Water Resources Commission has given approval to a $100,000 loan to Indianapolis which will enable the city to start a $7,500,000 flood control project along White River and Fall Creek.

The money will come from the state's new flood control revolving fund, and permit the city to complete final engineering plans for the project.

Hamlin Joins Taft Sanitary Engineering Center

William G. Hamlin, sanitary engineer specializing in waste control, has joined the Training Program staff of the Robert A. Taft Sanitary Engineering Center, Public Health Service, in Cincinnati, Ohio. He will assist in the formulation and presentation of specialized technical training courses in the water supply and water pollution field.

For several years, Mr. Hamlin has been in private practice and recently completed an engineering investigation and report on the combined sewage and industrial waste problem of Greendale, Indiana, and on the major producers of beverage spirits operating there.

He also has served on the staff of the Ohio River Valley Water Sanitation Commission. Before working with the commission, he was employed by the Proctor and Gamble Company, and helped to initiate their company-wide waste disposal engineering system.

Coaxing Water From The Clouds

Hugh A. Shamberger, Nevada's director of the State Department of Conservation and Natural Resources, has suggested that the state may have to coax more moisture out of the high Sierra cloudbanks if it is to keep up with the water needs of its expanding population.

He recommended that a research program on "weather modification" be instituted as soon as possible to develop means of increasing snowfall on the high watersheds in northern Nevada, and thus swell the spring and summer runoffs.

In 1946, Dr. Vincent Schaefer demonstrated that precipitation could be produced artificially by supercooling or "seeding" clouds. The area east of the Sierra Nevada range was recommended by Dr. Schaefer for experimentation since 60% of the state's stream flow originates in the Sierra.

Continued on page 11A

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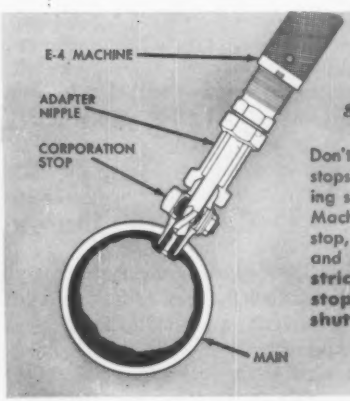

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News—Here & There

CONTINUED FROM PAGE 9A

Georgia Group Creates Wastes Section

The creation of a Wastes Section within the Georgia Water and Sewage Association has been recently announced by the parent organization. Its purpose is to establish new opportunities for advancing both practical and theoretical knowledge of waste treatment among its members.

The new section will have its own officers who will be added to the Executive Committee of the Association. This year the new section will be guided by C. E. Drummond, Jr. He will be succeeded next year by Louis Simonton.

It is expected that, with the establishment of the Wastes Section, a more strongly knit organization for the exchange of information in this field will result.

Delaware River Storage Projects Planned

Proposals for the construction of 17 major water storage projects on the Delaware River were announced by the U.S. Army Corps of Engineers at a conference sponsored by the Interstate Commission on the Delaware River Basin and the Delaware River Basin Advisory Committee.

These projects would be built throughout the basin of the 326-mile river in the states of New York, New Jersey, Pennsylvania and Delaware. The area of the basin has a population of about 22,000,000 people.

In addition to the 17 new projects, the Corps proposed the reconstruction of two water storage reservoirs in Pennsylvania. They also are considering the construction of a Delaware estuary barrier dam as another part of their overall plan. This dam would be built across the relatively narrow part of the Delaware River, below New Castle, Del.

The purpose of the dam would be to provide water of acceptable saline content for the future industrial and residential needs of Sussex, Kent, and New Castle counties in Delaware, which includes the city of Wilmington.

The proposals are expected to comprise the principal part of the recommendations contained in the final report that will be made by the Philadelphia District of the Corps of Engineer. The study forming the basis of the report will then have taken three years to compile at a cost of $2,000,000.

It is hoped that the recommendations will provide the basis for a solution to the troublesome problem concerning the development of the Delaware that will last to the year 2010.

Almost Two Billion Feet of Sewer Pipe

and fittings will be required by sewerage utilities for new construction, maintenance, and repair between 1959 and 1975, if adequate public sewerage facilities are to be available in 1975. This announcement was made recently by the Water and Sewerage Industry and Utilities Division, Business and Defense Services Administration, of U.S. Department of Commerce.

A recently published study by the Division discusses the future requirements of sewer pipe and fittings for public utilities, industrial, military and other Federal systems, and also reviews past trends. The estimated requirements do not include sewer pipe used for transporting industrial fluids other than liquid wastes; nor do they cover house connections to street mains, culverts, drainage pipe, and storm sewers included in street paving construction, since statistics for these categories are not available.

The report includes in its coverage the three principal types of pipe used for sanitary and storm sewerage collection and disposal: vitrified clay, concrete, and asbestos-cement. For convenient correlation with end use, the pipe requirements are grouped into three classifications: 8" to 12"; 15" to 24"; and over 24" diameters.

The purpose of the study is to aid manufacturers in planning to meet future demands. Entitled, "Sewerage Utilities, Sewer Pipe Requirements for Mains, 1920-1958-1975", it is available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at 5c a copy.

Water Program Recommended for Kentucky

The Kentucky Water Resources Study Commission has issued a report to Governor Chandler and the 1960 state legislature recommending a nine-point program designed to emphasize the importance of water in the state's overall needs. Commission Chairman Lee Bolin said the report would be submitted to the new legislature in January and would recommend:

1—Further development of public awareness in water resources programs.

2—Better and more economical methods for treating water for domestic uses, as well as for treatment of sewage and industrial wastes.

3—Additional studies of water uses and needs for small watersheds throughout the state.

4—A statewide program for investigating and mapping underground water.

5—A survey of waterfront areas to zone or reserve the best sites for future industrial expansion, especially those industries requiring large water supplies and water transportation facilities.

6—Establishment of a fair water rights law.

7—Creation of a central state agency to have jurisdiction over the principal water activities in Kentucky.

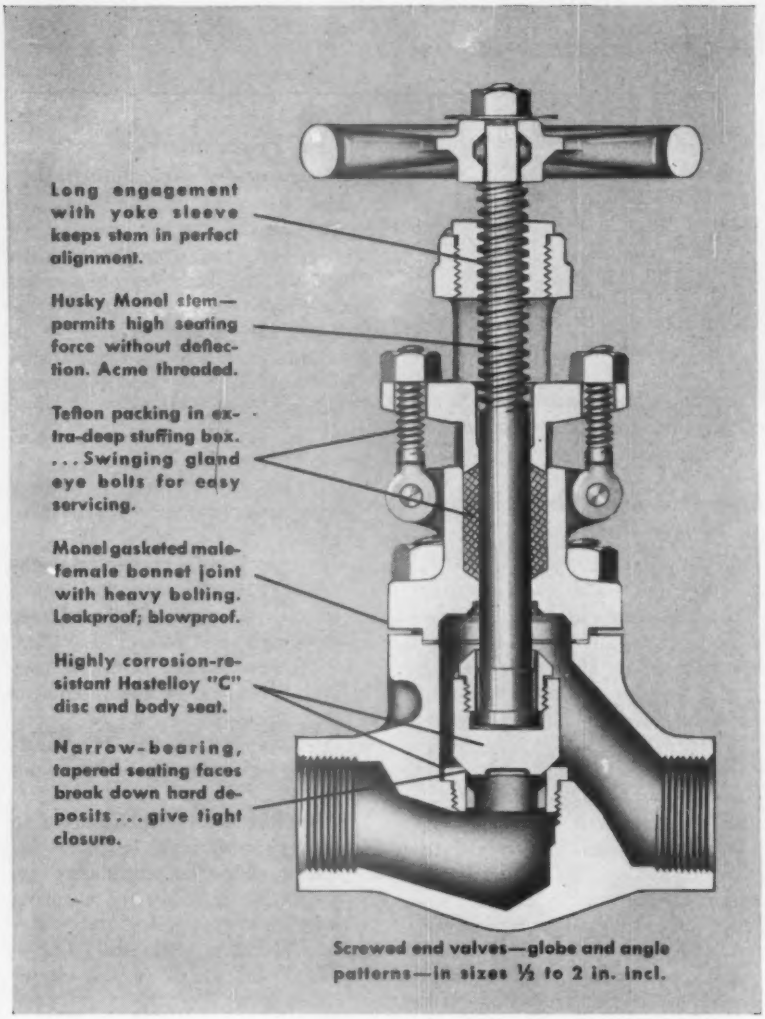
8—A program of financial assistance for areas without money so municipalities may build, operate or expand water treatment facilities.

9—A law requiring the registration of all outboard and inboard motorboats having over 10 hp, if they are to be used on navigable streams.

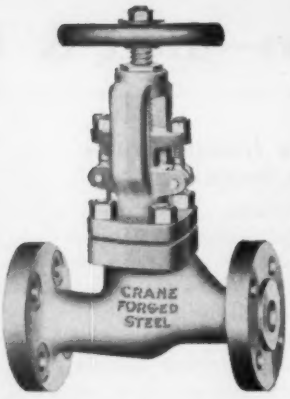
Wells Acting Up

Two city wells at Tulelake, California, suddenly have developed tremendous artesian pressures that at times have lifted their five-ton pumps slightly off their foundations. The well-water temperatures rose from 68 to 75 degrees.

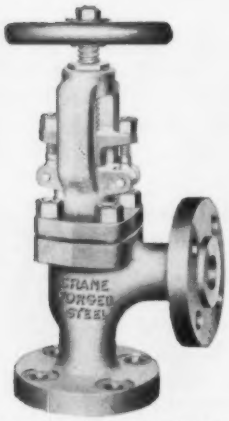
Inasmuch as the wells are more than a half-mile deep, the theory has been advanced that subterranean volcanic action is responsible.


Long engagement with yoke sleeve keeps stem in perfect alignment.
Husky Monel stem—permits high seating force without deflection. Acme threaded.
Teflon packing in extra-deep stuffing box. . . . Swinging gland eye bolts for easy servicing.
Monel gasketed male-female bonnet joint with heavy bolting. Leakproof; blowproof.
Highly corrosion-resistant Hastelloy "C" disc and body seat.
Narrow-bearing, tapered seating faces break down hard deposits . . . give tight closure.

Screwed end valves—globe and angle patterns—in sizes ½ to 2 in. incl.



Flanged end globe valve—in sizes ½ to 6 in. incl.



Flanged end angle valve—in sizes ½ to 2 in. incl.

NEW! Crane chlorine valves now in sizes up to 6 in.

Performance-proved over many years in sizes up to 2 in., these *engineered-for-chlorine* valves are now available in larger sizes with flanged ends—2½, 3, 4 and 6 in.

Many features put these valves head and shoulders above any other for gas or liquid chlorine handling. There's extra strength where needed in the steel body and integral bonnet and yoke. The bonnet joint is gasketed with Monel and heavily bolted; it's leakproof and blowproof. A deep stuffing box with Teflon V-ring packing insures long-life stem seal.

Disc and body seat ring are Hastelloy "C" for tight seating with high corrosion resistance. Narrow-bearing, 45-degree taper seating design and the husky Monel stem easily break down any hard deposits on seat faces.

Choose these valves for all water-free chlorine gas or liquid services up to 300 F. They're ideal for chlorinating lines in chemical processing and bleaching, treatment of water and sewage, etc. Get complete specifications from your Crane Representative or write to address below.

CRANE® VALVES & FITTINGS

PIPE • PLUMBING • HEATING • AIR CONDITIONING

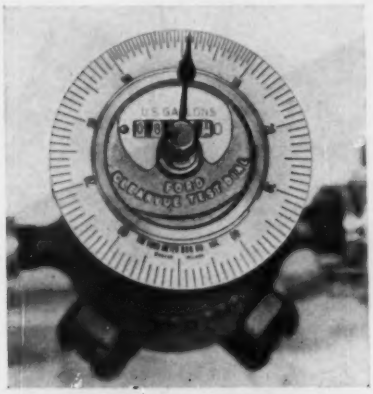
Since 1855—Crane Co., General Offices: Chicago 5, Illinois—Branches and Wholesalers Serving All Areas

Equipment News

Test Dials For Meters

1201

Ford Meter Box Co., Wabash, Ind., have announced the availability of their Clearvue Test Dial which enables meters to be read accurately to ½ of 1%. The dial may be used on any straight or round register be-



tween 2½" and 3" in diameter, except those having a sweep hand in the center.

A calibrated aluminum ring, 5" in diameter, which may be turned to various positions at the start of a test, permits meter reading in gallons, cubic feet or liters.

Total Flow Meter

1202

Leupold & Stevens Instruments, Inc., Portland, Ore., has announced the availability of a new Stevens Total Flow Meter designed to measure the flow of sewage, industrial wastes, irrigation water and other liquid flowing in open channels. The new model is lightweight, portable and simple to install, and is completely mechanically operated.

Total volume of flow through standard weirs or Parshall flumes may be read from a counter-totalizer while instantaneous rate of flow and head are indicated by a pointer and scale. A red index sliding on the indicator scale and driven by the pointer indicates peak flow. The total volume that has passed through the Parshall flume or weir is registered in cubic feet by five digits on a counter and two on a calibrated disk. Flow indication is in cubic feet per second, and instructions included with the meter have simple formulas for converting the totalizer and flow scale to other volume and flow units.

The instrument is housed in an aluminum case and gasketed to seal out moisture. Corrosion resistant metals are used throughout and the bearings are the lifetime lubricating type. The meter can be installed in a manhole or vault with no additional protection needed to resist condensation or corrosive fumes.

New Paint Process

1203

Blaw-Knox Company, Pittsburgh, Pa., announced the development of a new paint process that increases steel grating resistance to wear, abrasion, corrosion, chemicals and weathering.

In this new Ponbake process, the grating is cleaned and phosphatized in one operation. Then, an epon base, high polymer synthetic paint is applied through a "flow-kote" method which provides coverage up to 1-mil minimum thickness. Finally, the grating is baked at 350°F to cement the bond between the paint and the metal.

The procedure includes a cleaning and "minit-kote" of two per cent phosphate solution heated to 180° F, which is applied with a power spray washer. Flow-kote application of the epon base paint is accomplished with a series of top and bottom sprays positioned to provide 1-mil thick cover.

Automatic Plug Valve Operator

1204

Roto Hammer Company, Tulsa, Okla., had made available a plug valve operator and automatic lubricator that is a self-contained mechanism operating without pneumatic or electrical power.

It provides a ground level control for remote operation of overhead plug valves, and permits valves in overhead lines to be installed in straight runs, thereby eleminating the need for platforms or for routing piping to ground level. It may also be used as a hand operator for overhead valves from ground level and as a hand operator for valves installed at the ground level.

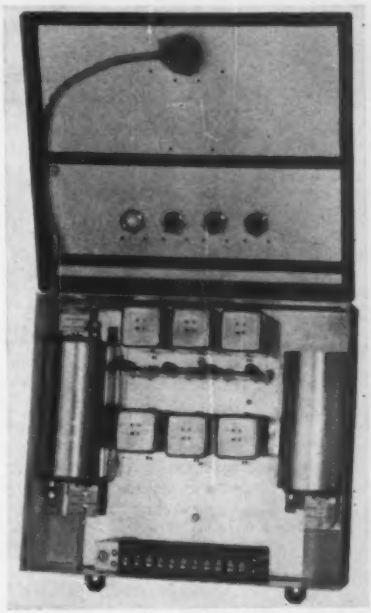
New Electro-Pneumatic Control Unit

1205

Synchro-Start Products, Inc., Skokie, Ill., have made available a new Electro-Pneumatic Control unit that gives accurate, on the second, cranking cycles, and which protects the gasoline or diesel engine as well.

Each of the three Electro-pneumatic units, (cranking cycle, rest cycle, and total cranking cycle), are individually adjustable from 0 seconds to 120 seconds. Since they are pneumatic, they keep precise timing regardless of the battery's voltage variations.

A steel, dust-proof cabinet with "knock outs" houses the new unit. The six relays are firmly locked in their sockets by simple closing the front panel, and neither shock or vibration can unseat these relays



once the panel has been closed. Two plug-in relays simplify servicing, and the overload breakers eliminate the necessity of storing spare fuses.

Other features include a switch on the front panel which allows the operator to select "Automatic", "Off", "Manual Operation" conveniently. Warning lights are also mounted on the panel for "Over Crank", "Oil", "Water", and"Over Speed" conditions needing attention.

CONTINUED ON PAGE 17A

R-C AIR BLOWERS, VACUUM PUMPS AND GAS METERS

Selected for Miami's $27-million Pace-setting Sewage Disposal Project

Eight years of preparation and three years of construction have given the City of Miami one of the most modern, integrated sewage disposal systems in the country. An overall pollution abatement program included the construction of intercepting sewers, pumping stations, a force main across Biscayne Bay, a treatment plant on Virginia Key, and an outfall extending nearly a mile into the ocean. The sewage treatment plant is a high-rate activated-sludge type with a designed capacity of 47,000,000 gallons per day, estimated to meet the city's needs until 1965.

In such an installation as this, where operation is continuous and largely mechanized, only the best, most reliable equipment will serve. In many areas throughout the plant where air or gas were to be handled, Roots-Connersville equipment was selected, because only R-C equipment could meet the exacting specifications. And only R-C equipment could deliver the kind of performance required in this service—dependable, around-the-clock operation with a minimum of maintenance. For no other manufacturer has had so many years of experience producing air and gas handling equipment for sewage treatment applications.

The R-C equipment selected for the Miami sewage treatment plant includes three rotary air blowers for grit removal, four rotary blowers for the aeration tanks, two rotary vacuum pumps for sludge dewatering, and five rotary gas meters for measuring sludge gas. All these units utilize the well known "Roots" rotary positive displacement principle to assure top performance for long years of service.

R-C blowers, pumps and meters such as these are available in a wide range of sizes and capacities to meet every standard or special application. In addition, Roots-Connersville produces centrifugal blowers and Spiraxial® compressors. All are backed by the unmatched reputation established by Roots-Connersville in more than a century of manufacturing air and gas handling equipment.

ROOTS-CONNERSVILLE BLOWER
DIVISION OF DRESSER INDUSTRIES, INC.
1259 Garden Ave., Connersville, Ind. In Canada—629 Adelaide St., W., Toronto

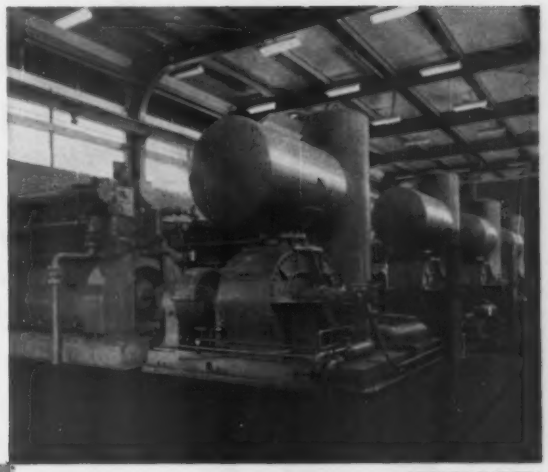
Additional data about Roots-Connersville equipment appears in **Chemical Engineering Catalog, Mechanical Catalog and Sewage Manual.** *Or write us for specific information about any problem in the handling of gas or air.*

CITY OF MIAMI
SEWAGE TREATMENT PLANT
MIAMI, FLORIDA

DEPT. OF WATER AND SEWERS, CITY OF MIAMI
C. E. Wertz, Director
Garrett Sloan, Chief Engineer
David P. Blackmeyer, Superintendent

ENGINEERS
Metcalf & Eddy, Boston, Mass.

CONTRACTOR
Paul Smith Construction Co.
Tampa and Miami

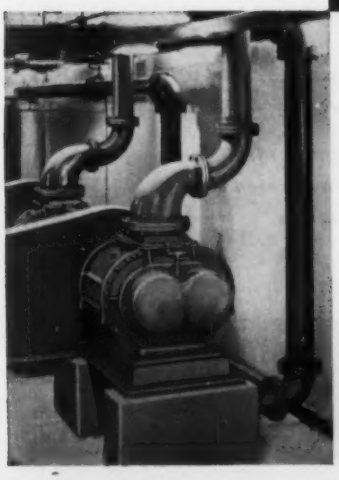


AERATION BLOWERS

Air for the aeration tanks is supplied by these four 24 x 28½ rotary positive displacement blowers of the two lobe type. Each blower has a capacity of 10,400 cfm at a discharge pressure of 7.5 psig and is driven at 514 RPM by a 410-HP engine. Two engines are dual-fuel engines and the other two are spark-ignition gas engines.

GAS METERS

R-C rotary positive displacement meters are used to measure the sewage sludge gas produced in the digestive process. This gas is supplied as fuel to the engines driving the aeration blowers. Illustrated is a 4 x 12 low-pressure meter handling 10,000 cfh of sewage sludge gas. Four other 3½ x 10 R-C meters are also used, each with a capacity of 6000 cfh.

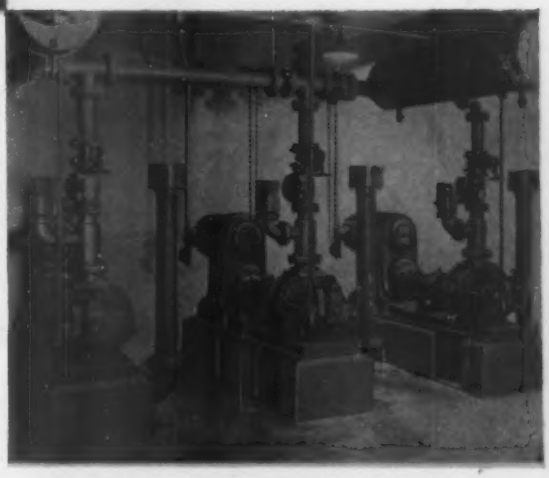


GRIT CHAMBER BLOWERS

In the grit chambers, these three R-C rotary blowers supply air to remove grit from incoming raw sewage. Each unit is an 8 x 8 blower driven at 320 to 640 RPM by U.S. Varidrive, discharging against 7 psig. The blowers furnish up to 6.3 cubic feet of air per lineal foot of tank when all three blowers and two tanks are operating.

VACUUM PUMPS

After elutriation, sludge is dewatered. These two 14 x 21 rotary blowers are used as dry vacuum pumps on dewatering filters. Each pump has a capacity of 1,630 cfm and provides a vacuum of 12 to 15 inches Hg., referred to a 30" Hg. barometer, when operating at 415 RPM.



NOW!

improved... streamlined... modernized...the

EDDY Hydrant

has ALL these features...

★ *Optional ground line break flange*
★ *Large diameter barrel for increased flow*
★ *O-ring or standard packing*
★ *New self-sealing rubber ring main valve packing*
★ *No lubrication required for fast, easy opening*
★ *Opens with the pressure—for instantaneous flow*
★ *Closes against the pressure—eliminates water hammer*

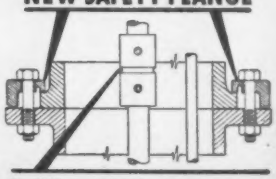
The EDDY Hydrant...improved... streamlined...modernized...retains all the basic advantages that have made these hydrants outstanding for four generations. Yet, it has important new advanced design features which provide the utmost in efficient, dependable, longlife fire protection service.

These new important advantages are provided without sacrificing interchangeability of working parts with EDDY hydrants now in service. Now, more than ever, EDDY offers maximum fire protection, economical maintenance and assurance against future obsolescence in your fire-fighting system.

Before buying or specifying hydrants, be sure you know how these advantages may benefit your community.

Optional break flange gives double protection against impact damage

NEW SAFETY FLANGE



NEW SAFETY COUPLING

EDDY VALVE COMPANY
A Subsidiary of James B. Clow & Sons, Inc.

WATERFORD NEW YORK

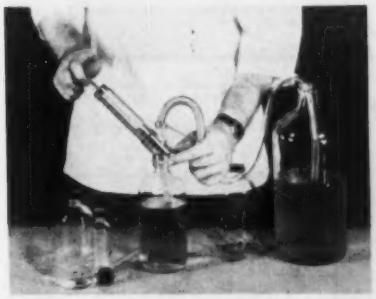
Equipment News

CONTINUED FROM PAGE 13A

Vacuum Pump

1206

W & W Manufacturing Company, Chicago, Ill., has developed a versatile, light-weight vacuum pump named the "Golden Thief" which meets the need for an easy method of sampling where contamination must be avoided and where highly corrosive liquids are encountered.



The Model D will handle liquids having consistency up to that of syrup, and powdered solids that have a tendency to "slump" or seek their own level. The lift of the pump is approximately 25 feet of water at sea level.

Motive power is provided by the vacuum created in the sampling container on the up-stroke of the pump handle. The material being sampled never comes in contact with any part of the pump but passes through the sanitary tubing from the sampling source directly to the sample container. Additional advantages of these features are easy cleaning and low maintenance.

The Model D, "Golden Thief" is available in both stainless steel and aluminum. Since parts are interchangeable, the pump may be furnished in various combinations according to specific needs. The equipment fits neck-opening sizes from 22mm. to wide-mouth mason jars, and can be used to transfer materials to smaller containers.

Plastic Foot Valve

1207

Chemtrol, Lynwood, Calif., has announced the availability of a new footvalve of all-molded plastic construction which is designed for use in sumps, tanks, or wherever fluid level must be reduced or the fluid completely withdrawn. The valve is completely inert to corrosion and corrosive influences.

Back flow is prevented by the incorporation of a ball-type check valve, and the suction end is completely protected against intake of debris with a large, hemispherical plastic screen.

The new model is furnished in a full range of sizes from ½" through 2". Connectors are available in IPS threads or in standard socket dimensions for solvent welding.

One Coat Protective Coating

1208

Prufcoat Laboratories, Inc., Cambridge, Mass., announces the availability of the newly developed Primastic protective coating that combines rust inhibitive properties with the chemical resistance of a catalyzed epoxy coating.

This new product requires only one brush or single-pass spray coat for a coating up to 10 dry mils in thickness. One cross-pass spray coat yields a 20 mil dry film thickness. Flash point exceeds 100° F.

It is said that Primastic requires "only minimum surface preparation", that sandblasting is rarely necessary, and that no special equipment is needed so the new product may be applied by a company's regular forces.

Non-Skid Safety Grating

1209

Bustin Steel Products, Dover, N. J., has announced it is offering a new, safety grating and all-purpose grille consisting of descaled, skid-proofed bars which are formed into honeycomb design and welded by an exclusive hydroelectric pressure method.

Called "Protecto", the grating features a plain surface on one side and, on the other, a non-skid serrated edge that eliminates slipping in the direction of the bearing bars even when completely submerged in grease. The full-depth, honeycomb design gives the grating forming qualities and permits it to acquire great rigidity. The product weighs only 3 pounds per square foot and may be used as a floor or wall armouring.

Chlorine-in-air Detector Kit

1210

Mine Safety Appliances Company, Pittsburgh, Pa., has announced development of a new field detector kit for the measurement of chlorine-in-air in concentrations ranging from one-half to 20 ppm.

The new instrument employs an aspirator bulb for drawing samples across a "break-tip" detector tube containing an impregnated silica gel. The amount of chlorine in air is indicated by the proportional length of blue stain created by reaction of the chlorine with the silica gel.

Housed in a carrying case, the kit is furnished with 12 detector tubes. The instrument permits sampling from remote locations, and sampling lines are available in 10, 25, and 50 foot lengths.

High Speed Squirrel Cage Motors

1211

Ideal Electric and Manufacturing Co., Masefield, Ohio, has announced that new, high speed, squirrel cage, induction, vertical motors are being offered in 150 H.P. and up and in frames 584 and larger. Designed and constructed for all types of vertical motor service, they are especially suited for unattended, intermittent duty installations.

Heavy duty, reinforced fabricated steel frames are used in construction. Deep-bar copper rotors with extended ends for maximum heat dissipation are ventilated to permit air passage through the cores and windings for low, uniform, internal temperatures. The motors are furnished with either solid or hollow shafts as required.

CONTINUED ON PAGE 19A

Couples in seconds...
stays water-tight
TYLOX Gaskets form water-tight, compression seals automatically as pipe is coupled. They keep their elasticity, and stay water-tight for the life of the pipe itself.

TYLOX Rubber PIPE GASKETS

It takes only a few seconds to couple Tylox-Gasketed sewer pipe, but even more important than that, finished joints *stay* tight, preventing leakage in or out, and making future maintenance unnecessary by eliminating root and sediment problems. The installation above was a joint project of the Virginia Polytechnic Institute and the Town of Blacksburg, Virginia, R. Stuart Royer & Associates, Consultants, Richmond, Va. Pipe work was by Gimbert and Gimbert Construction Co., Roanoke, Va., and 15" Tylox-Gasketed Pipe was furnished by Roanoke Concrete Products Co., Inc., also of Roanoke.

Pipe joints formed with Tylox rubber Gaskets stay tight because they keep their original elasticity. Under ground and under compression, sewerage and industrial waste acids won't deteriorate the specially compounded Tylox rubber, and pipe angularities from shifting soils or overburdens can't break their seal. Leakage, with resultant evils of root and sediment penetration is whipped because it *can't start!* Waste disposal designers and builders know this . . . and it is why there are more TYLOX Gaskets in low head service than all other types of gaskets combined. As for speed of assembly, there's no joint that can be coupled any faster than TYLOX.

WRITE FOR MORE TYLOX INFORMATION

if you are not thoroughly familiar with its time-saving, cost-saving engineering advantages. Tylox Joints are the one sure way to get water-tight pipe lines at less pipe-laying cost.

HAMILTON KENT
MANUFACTURING COMPANY
KENT, OHIO
427 West Grant St. ORchard 3-9555

CANADIAN PLANT: 10 Brussels St., New Toronto, Ont., CLifford 1-2494

5134

Equipment News

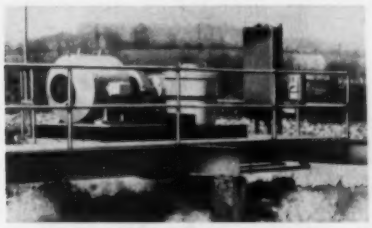
CONTINUED FROM PAGE 17A

Turbine Type Aerator

1212

Infilco, Inc., Tucson, Ariz., is offering its new "Vortair" turbine type mechanical aerator which introduces atmospheric oxygen into an aeration basin or lagoon at any desired rate.

The aerator is so shaped and mounted in relation to the surface of a body of liquid, and rotated at such a speed that it draws large quantities of air from the atmosphere into the liquid. It also keeps the liquid mixed and distributes oxygen through a large mass of circulating liquid.



Power consumption, according to field data released by the company, indicates that it is possible to dissolve 2.5 to 3.0 pounds of oxygen per hour per horsepower.

Vinyl Pipe Protection Tape

1213

Minnesota Mining and Manufacturing Co., St. Paul, Minn., has announced availability of its new, pressure-sensitive, vinyl pipe protection tape that was "designed specifically for wrapping straight pipe sections". Called "Scothrap", it will not rupture with the stopping, starting or jerking of a taping machine, and is designed to machine-wrap smoothly at any taping angle.

Company figures show the new, 10-mil, funginert tape has an elongation at break of 250%, adhesion of 45 ounces per inch width, tensile strength of 30 pounds per inch width, tear resistance of 2100 grams in the machine direction and 2700 grams in the cross direction, and a puncture resistance of 11.5 pounds. Its electric strength is 13,000 volts and its insulation resistance is 1×10^6 megohms at 96% R.H.

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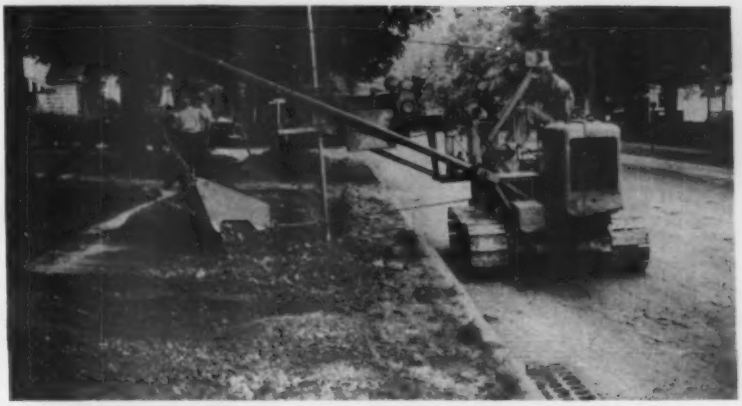
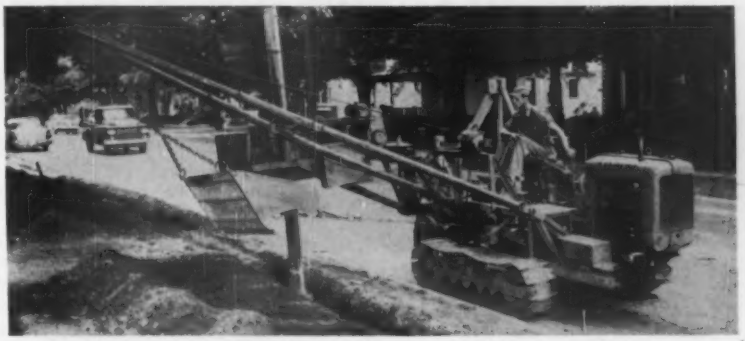


Job photos don't lie . . .

See from these photos how the Cleveland 80W's ability to pull backfill into trench permitted spoil to be placed off the street, away from the curb—no blocked-up catch basins, no need to lift backfill over curb, no interference with traffic (good public relations!). Note also how the one-man-operated 80W first backfilled and tamped driveways, making them ready for immediate use (more good public relations!) then backfilled and tamped the rest of the trench.

but they tell only part of the CLEVELAND 80W story

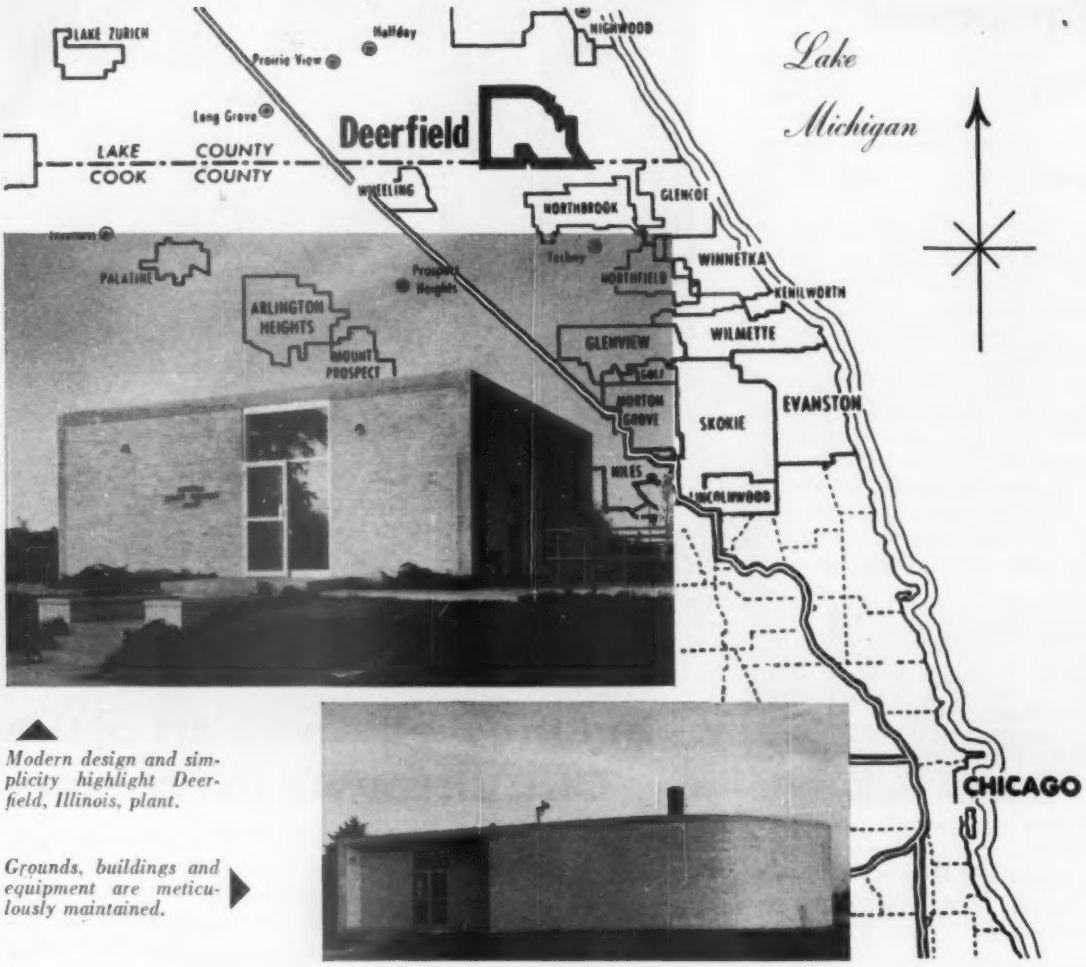
But you've got to see the 80W in action to really appreciate it—a cost-cutting versatile machine that fits so many different underground construction jobs. It handles and lays pipe—sets valves and hydrants—pulls street crossings—backfills fast *from either side* of trench, toward or away from itself—simultaneously tamps fill to the most rigid specifications—does a complete clean-up job.



The CLEVELAND TRENCHER Co.

20100 ST. CLAIR AVE. • CLEVELAND 17, OHIO

Good Everywhere



Modern design and simplicity highlight Deerfield, Illinois, plant.

Grounds, buildings and equipment are meticulously maintained.

Deerfield's Sewage Treatment Plant well prepared for suburban growth

Deerfield, Illinois, is now ready, willing and able to assimilate the tremendous suburban growth in the Chicago area.

Their beautiful new sewage treatment plant is kept in tip-top condition inside and out, reflecting the community's pride in this civic asset.

Just a few years ago Deerfield had a population of several thousand. Their new plant is constructed to serve 7,500 persons and further expansion can be made most economically.

Baxter and Woodman, Crystal Lake, Illinois, are the Consulting Engineers. They *specified* the most modern equipment available including P.F.T. Floating Cover, Heater and accessories for complete controlled operation of digester.

Deerfield is one more progressive community providing adequate sewage treatment facilities for their expanding future.

Waste Treatment Equipment
Exclusively since 1893

P.F.T.

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
Chicago 13, Illinois

PORT CHESTER, N. Y. • SAN MATEO, CALIF. • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

Equipment News

CONTINUED FROM PAGE 19A

Digester Cover Position Indicator

1214

Vapor Recovery Systems Co., Compton, Calif. has announced the recent introduction of its new "Var-rec" cover position indicator for digester roofs.

Powered by a "Neg'ator" motor, an exclusive, long deflection constant force spring element the new indicator uses no counterweight. The indicator is connected to the cover by a steel cable, which runs through piping over the digester wall by means of two 90° elbow sheaves. If desired, the cable terminal need not be fastened to the cover, but may be attached to a weight which rests on the cover top.

Calibrated for a ten-foot range on a large, easily read dial, the indicator may be adjusted for a greater range where required. It may also be equipped with an electrical high-low limit switch to actuate signal lights or horns.

Sewer Cleaner

1215

O'Brien Manufacturing Corp., Chicago Ill., has announced the introduction of an improved bucket machine and truck loader to their Sewerking line. Designed to remove

large deposits of sand, silt, roots and other heavy obstructions from sewers, the new unit operates completely by

CONTINUED ON PAGE 23A

NEW! Monoflange valve is guaranteed drop-tight at 150#

The Henry Pratt Monoflange MK II is a top quality butterfly valve that fits between the pipe flanges of a fluid or gas line. **It saves weight, space and labor** because it eliminates a pair of flanges and requires only one bolting operation. **It eliminates gaskets** because the faces as well as the inside of the valve body are covered with rubber permanently bonded to the metal.

Low torque makes the Monoflange easy to operate, especially with Henry Pratt's **new SIDEWINDER manual operator.** Any type of power operator can be used if desired. Structural features include streamlined disc, one piece shaft, chevron packing and Nylon bearings. Various materials available for corrosive liquids.

Standardized and mass produced, this new valve offers famous Henry Pratt quality at a new low price . . . you can't find a similar valve that offers so much in quality or performance.

Complete information available. Water and gas flow data, valve sizing, operator selection in 26 page brochure. An ideal tool for the engineer working with and specifying valves. Write for Bulletin 10-B.

Creative Engineering for Fluid Systems

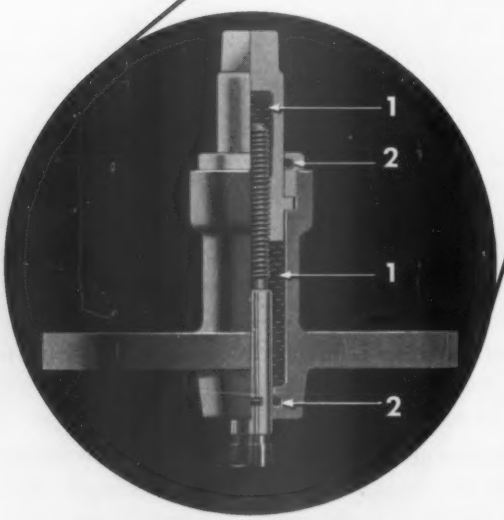
HENRY PRATT®

Monoflange MK-II
RUBBER SEAT BUTTERFLY VALVE

Henry Pratt Company, 319 W. Van Buren St., Chicago 7, Ill. • Representatives in principal cities

WHAT'S INSIDE? A BIG PLUS

AUTOMATIC LUBRICATION AND DOUBLE "O" RING SEALS



Smith Fire Hydrants are easy to operate, inexpensive to maintain and most dependable in meeting severe climate and operating conditions. In addition to maximum flow and simplicity of design, Smith Hydrants now have two additional features of major importance: (1) Automatic lubrication — chamber sealed with "O" Rings contains a permanent type lubricant—temperature range −30° to 200°F. Each time the hydrant is operated, the threads and bearing surfaces are automatically lubricated. (2) "O" Ring Seals — the lower "O" Ring seals the internal pressure, the upper "O" Ring is a combined external dirt and moisture seal. This construction eliminates the conventional stuffing box and packing gland adjustments. These and other well-known Smith superior design features assure positive operation, minimum maintenance and long service life.

64

FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE . NEW JERSEY

Equipment News

CONTINUED FROM PAGE 21A

power greatly reducing labor and job time.

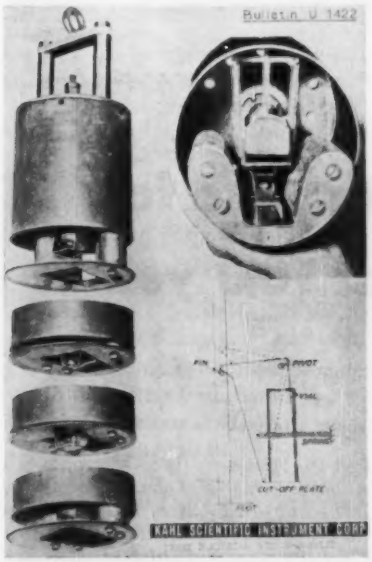
The new machine is built for heavy duty and safety, and incorporates many automatic control features. It is offered in 9, 16, and 25 H. P. sizes.

Particularly interesting in a model that has a continuous dumper feature which takes the bucket loads as they come from the sewer and conveys them directly to a loading truck.

Bacterial Bottom Sampler

1216

Kahl Scientific Instrument Corporation, El Cajon, Calif., announced the development of a new bacterial bottom sampler designed to obtain undisturbed sediment samples for bacteriological investigations, particularly of pollutants near sewage outfalls.



Upon contact with the bottom, a plate uncovers a sterile vial which permits material to enter. The plate then snaps forward cutting off a slice of the bottom which remains trapped in the vial. Samples may be used for coliform or other type study, and may be taken at any depth or type of water.

CONTINUED ON PAGE 25A

ERP At Work

This quiet scene should not mislead. Electro Rust-Proofing *is* hard at work. There's no hustle or bustle . . . just dependable, continuous cathodic protection.

Underneath this water an ERP-engineered protection system fights rust—fights maintenance costs. The battle was joined before installation. ERP Engineers surveyed the plant . . . designed and installed a system that gives maximum protection at lowest cost. And now ERP Service follows up. Continuous protection is assured . . . maintenance costs are the lowest ever.

If you want to stop trouble before it starts, if you want to protect your investment in steel structures—quietly, efficiently, economically—use Electro Rust-Proofing Systems. ERP is preventive maintenance at work.

We'll be glad to send more information. Write Dept. E-51 94.

ERP CATHODIC PROTECTION SINCE 1935

ELECTRO RUST-PROOFING CORP.
A SUBSIDIARY OF WALLACE & TIERNAN INC.
30 MAIN STREET, BELLEVILLE 9, NEW JERSEY
CABLE: ELECTRO, NEWARK, N. J.

IF IT'S FREE FLOWING AND DRY

we have accurate reliable means of feeding it. For information about these dry chemical feeders *both gravimetric and volumetric...*

Write Dept. M-42.94

WALLACE & TIERNAN INCORPORATED
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

Some of the 69 miles of 24- to 126-inch reinforced concrete pipe needed for the Pittsburgh sewer project

Pittsburgh chooses concrete pipe for sewer system designed to last 100 years!

The 70 communities of the Allegheny County Sanitary Authority have planned 100 years ahead for their new intercepting sewer system. This big project involves 69 miles of sewers—30 miles in tunnels and the rest open trench construction.

Needed strength, durability and watertightness are assured by concrete pipe. Extensive testing proved these qualities. Total infiltration into the first 31 miles completed was less than 3 gallons per minute. In many contract sections infiltration was found to be zero.

Other communities everywhere are also finding that concrete pipe can be designed precisely to solve their sewer problems. And concrete pipe are readily available. For the giant Pittsburgh project, special casting yards—including all test equipment—were set up at convenient close-in locations to speed up schedules, keep costs low.

For helpful information on modern concrete pipelines of all kinds, write for free literature. Distributed only in the United States and Canada.

For the Allegheny County Sanitary Authority: John F. Laboon, Executive Director and Chief Engineer; Lawrence M. Gentleman. Deputy Chief Engineer; Richard J. Dougherty, Construction Engineer.

PORTLAND CEMENT ASSOCIATION

Dept. A12-29, 33 West Grand Avenue, Chicago 10, Illinois

A national organization to improve and extend the uses of concrete

Equipment News

CONTINUED FROM PAGE 23A

Diesel Pumps

1217

Carver Pump Company, Muscatine, Iowa, have introduced a new line of diesel powered pumps that range in capacity from 40 to 1600 gpm. These pumps are available in both self-priming and non-self priming types, and in sizes and models suitable for various irrigation and construction applications.

Seven Day Time Control

1218

Paragon Electric Company, Two Rivers, Wis., has made available a new, seven day time control which allows a weekly schedule with individual settings, and not only separates each day of the week but also day and night periods. With this new design, the company claims that any electrically controlled system can be turned on or off automatically at different hours of each day, or certain days can be omitted entirely. Settings can also be made in advance for an entire week and quickly changed on a moment's notice.

Designed for simple installation, the entire switch mechanism can be removed from the case by merely pressing a spring lock; no tools or screws are required. Other features include a multi-purpose operation device, and the manual "skip-trip" which consists of a hand trip which can transfer switch operation at any time, without disturbing the daily or weekly tripping schedules.

Sealed Electrode Floatless Pump Controller

1219

Chicago Pump Company, Chicago, Ill., has announced the availability of its new Sealtrode, sealed electrode floatless pump controller which may be used to control the operation of one or more pumps while protecting the control from debris, grease or corrosive material.

The electrodes are encased in a 2" protective support pipe having a flexible bulb on the bottom. As the liquid level rises in the basin, a hy-

CONTINUED ON PAGE 27A

In the background, a section of the new filtration plant at Miami, Fla. Thoroseal protects all its masonry.

Specify Thoroseal

Thoroseal is not a thin paint. It is a cement-based product which goes on in a heavy coat and actually becomes a part of the masonry beneath it and positively seals it against the erosion and penetration of moisture. It goes on quickly and easily—especially with our new wide brush technique. It pays to remember that when you are protecting masonry, the best product is always the least expensive. Standard Dry Wall has been in business since 1912. Its products speak for themselves.

Please send me your free new specification guide.

Name_____

Address_____

City_____ Zone____ State_____

Standard | **Dry Wall Products, Inc.**

Box X-(4) New Eagle, Pa.

Plants at New Eagle, Pennsylvania and Centerville, Indiana

BADGER'S COMPOUND WATER METER ASSURES FULL REVENUE FOR ALL WATER DELIVERED

Wherever water flow rates fluctuate considerably during the day — in schools, factories, hotels, theaters, apartment houses, dairies, laundries — Badger's compound meter assures economical, efficient service.

This compound meter combines Badger's disc and turbine meters to provide accurate registration at all rates of flow. You get the full revenue to which your water department is entitled for water actually delivered.

It is the industry's only compound meter where only one side operates at a time. A patented balanced compounding valve directs small streams through the disc meter, large streams through the turbine side... for accurate measurement of all rates of flow, less wear and longer service life.

Write for complete details now.

Badger Water Meters

BADGER METER MFG. CO. • 4545 W. Brown Deer Rd. • Milwaukee 18, Wisconsin • *Offices in principal cities*

Equipment News

CONTINUED FROM PAGE 25A

drostatic pressure is exerted on the flexible bulb, squeezing it and causing the displaced liquid of the bulb to rise in the support pipe toward the electrodes. The liquid level in the pipe will always equal the level of the liquid in which the controller is submerged. Thus, the rise and fall of the liquid within the pipe makes and breaks electrical circuits connected with the electrodes. The pump starters are connected with the electrodes by controller relays.

Protective Tape Coating

1220

Polyken Sales Division, of the Kendall Company, Chicago, Ill., has announced the development of a high-density, polyethylene protective coating for transmission pipeline application by tensioned-spindle equipment. The new tape requires no primer, no drying or cooling time, gives off no fumes, and is not a fire hazard.

Sewer Cleaning Tool

1221

Juswel Company, Columbus, Ohio, has recently made available a new, improved, self-rotating sewer cleaning tool named the "Root Hog". It is of heavy welded construction and has specially designed cutters which will not injure a pipe wall.

The "Root Hog" removes roots by double action, forward for cutting and reverse for dragging out the roots. Other features include a swiveled draw bar of tool steel for extra strength and a threaded ballast plug for weight control.

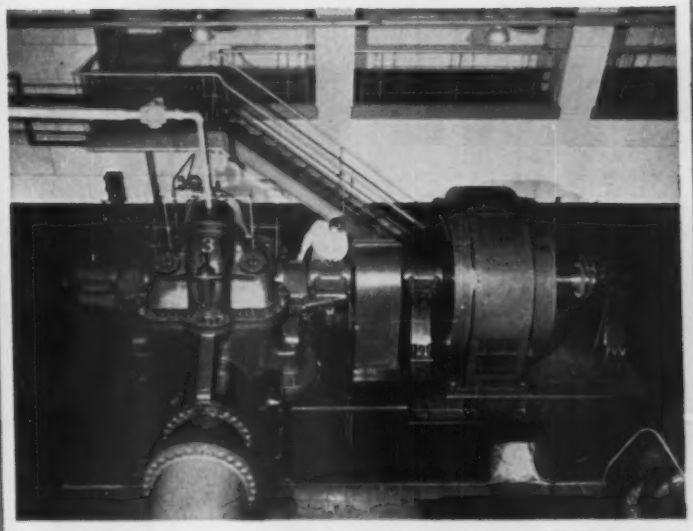
Fire Hydrant

1222

A. P. Smith Manufacturing Company, East Orange, N. J., is offering its new Model H100 fire hydrant, featuring bronze-to-bronze seat ring threads, permanent lubrication, and a unique design seat removal wrench.

This new hydrant conforms to current A.W.W.A. specifications and is available with 4⅝" and 5¼" internal valve openings for working pressures up to 150 lbs. When equipped with a high pressure pilot valve, the Model H100 is suitable for working pressures up to 200 lbs.

A case for F-M Split-Case Centrifugals!



Typical installation in Toledo averages 80.314% wire-to-water efficiency for year!

Exceptionally high and dependable efficiency with steady, low-cost operation year after year—that's the report from a host of municipalities and industries using Fairbanks-Morse pumps in their pumping stations.

Why? Ask stations like Collins Park High Service in Toledo, O., where five Fairbanks-Morse 36-in. Split-Case Centrifugal Pumps have been giving superb performance for 17 years. The No. 3 pump in the photo pumped 6,065,590,000 gallons in one year alone, handling 26.13 percent of the plant total, and consuming just 3.55 kilowatts hours per million foot gallons!

Your Fairbanks-Morse Field Engineer welcomes you to inspect many other reports like this from his files—reports revealing why no other manufacturer can match the experience of Fairbanks-Morse in providing pumps and drivers for both municipality and industry. Your F-M Field Engineer will be glad to work with your own engineers in selecting the best equipment for your specific requirements. Write Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.

See Sweet's Product Design Catalog File for complete F-M Pump Line.

FAIRBANKS-MORSE
a name worth remembering when you want the BEST

PUMPS • SCALES • ELECTRIC MOTORS • DIESEL, DUAL FUEL AND GAS ENGINES
LOCOMOTIVES • COMPRESSORS • GENERATORS • MAGNETOS • HOME WATER SYSTEMS

"K&M" ASBESTOS-CEMENT SEWER PIPE

INFILTRATION-PROOF AT 25 PSI PRESSURE

Tests prove that the exclusive, patented "K&M" FLUID-TITE Coupling maintains a permanently infiltration-proof seal under severest field conditions.

This is true even when "K&M" Asbestos-Cement FLUID-TITE Sewer Pipe is under deflection, or is buried at various depths under heavy backfill. Tests prove this infiltration-proof pipe can withstand 25 psi external water pressure.

In addition to its tight sealing, "K&M" Asbestos-Cement FLUID-TITE Sewer Pipe is non-corrosive and completely immune to electrolysis. Its bore—with a Manning Factor of n-0.010—remains smooth and clean for full, unobstructed flow.

That's why there's a minimum of maintenance with this hardy pipe. It reduces treatment loads and costs. Requires fewer periodic inspections and cleanings.

There are five classifications of "K&M" Asbestos-Cement FLUID-TITE Sewer Pipe to meet your crushing strength requirements. To simplify planning and design.

Eliminate the problem of infiltration with tested and proven "K&M" Asbestos-Cement FLUID-TITE Sewer Pipe. Write to us today.

5 CRUSHING STRENGTHS OF "K&M" ASBESTOS-CEMENT FLUID-TITE SEWER PIPE

Size Inches	Class 1500	Class 2400	Class 3300	Class 4000	Class 5000
6	1500	2400	3300		
8	1500	2400	3300		
10	1500	2400	3300	4000	5000
12	1500	2400	3300	4000	5000
14	1500	2400	3300	4000	5000
16	1500	2400	3300	4000	5000

K·M
BEST IN ASBESTOS

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

Mr. Mayor! Mr. City Commissioner! Mr. City Engineer!

Proved PERFORMANCE—Not Promises Backs CAST IRON PRESSURE PIPE

Your taxpayers have entrusted you with a decision—long-range in nature and far-reaching in consequences—to purchase pipe for your community's water system addition. Whether you borrow money or use current funds, you can't afford to take a chance on pipe that is unproven, with many failures in less than 20 years.

CAST IRON PRESSURE PIPE

Has Established Its Superiority With Many Records of Service Like These:

at MONTREAL since 1816	144 YEARS
at LYNCHBURG since 1828	132 YEARS
at PHILADELPHIA since 1830	130 YEARS
at RICHMOND since 1831	129 YEARS
at BALTIMORE since 1834	126 YEARS
at ST. LOUIS since 1834	126 YEARS
at READING since 1834	126 YEARS
at HUNTSVILLE since 1836	124 YEARS
at LANCASTER since 1836	124 YEARS

If you want more proof, we can supply it. Sixty-eight cities are still using Cast Iron Pipe more than 100 years old. Join the Century Club! Safeguard your city's welfare with the only pipe that has stood the test of time.

This advertisement is published in the interests of the Cast Iron Pressure Pipe Industry by .....

WOODWARD IRON COMPANY

Since 1882

WOODWARD, ALABAMA

News of Suppliers

Owens Gets Combustion Appointment

Combustion Engineering, Inc., New York, N. Y., has announced that Vincent P. Owens has been appointed Assistant General Sales Manager in charge of Industrial Products.

For the past ten years, Mr. Owens has been Manager of Paper Mill Equipment Sales. He will remain in charge of the company's Paper Mill Division sales and will supervise the sales of the Industrial Steam Generators, Raymond Division Equipment and Fabricated Products.

Mr. Owens has been actively associated with the paper mill industry since joining Combustion in 1936.

Rockwell Names Hicks Eastern Manager

Rockwell Mfg. Co., Pittsburgh, Pa., has announced the appointment of Raymond E. Hicks as Eastern engineering manager of the Water and Sewage Valve sales unit of the company's Meter and Valve Division.

Mr. Hicks joined Rockwell in 1951 as a senior sales engineer in the Philadelphia branch office. He will continue to work out of the Philadelphia office in his new capacity. Before joining Rockwell, he was associated with the Pittsburgh Valve and Fittings Company.

He is a graduate of the Georgia Institute of Technology.

Pennsalt Completing First Modernization Phase

Pennsalt Chemicals Corp., Philadelphia, Pa., has announced it expects to complete the first phase of a $6,000,000 modernization program of its Wyandotte, Michigan, chlorine-caustic soda facilities before the end of this year. The improvements now nearing completion include new 50% caustic soda facilities designed to reduce costs and improve quality.

The second major phase will be the replacement of several thousand Gibbs diaphragm-type electrolytic cells with a fewer number of more

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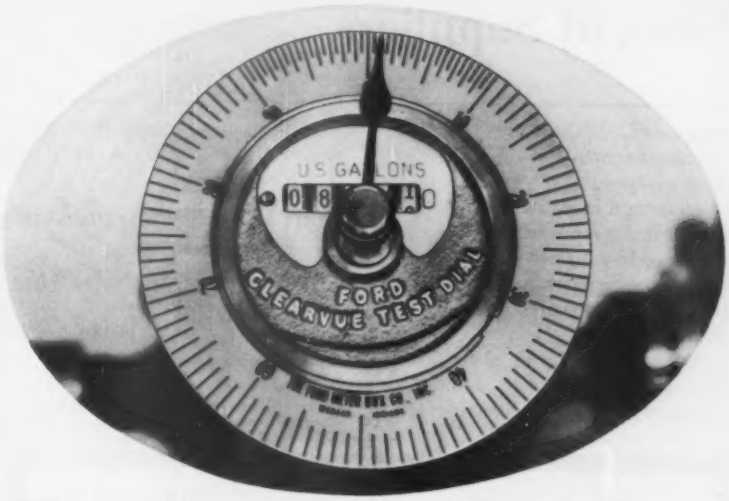


For Accurate Reading of Meters on Test . . .

Meter dials are read accurately . . . down to ½ of 1% . . . when equipped with the Ford Clearvue Test Dial. May be used on any straight or round reading register between 2½" and 3" in diameter, except those with a sweep hand in the center. It makes no difference whether meter reads in gallons, cubic feet or liters. Calibrated aluminum ring, 5" in diameter, can be turned to any position for start of test.

THE FORD METER BOX COMPANY, INC.
Wabash, Indiana

FOR BETTER WATER SERVICES FORD

VALVE OPERATION

DEAN TRUCK MOUNTED VALVE OPERATOR

MAKES EVERY VALVE POWER OPERATED

PAYNE DEAN & CO. CLINTON, CONN.

News of Suppliers

CONTINUED FROM PAGE 31A

economical, 30,000 amp. cells, and the improvement of auxiliary cell-room equipment. When the new cells go on stream in mid-1960, the facility is expected to produce chlorine and caustic soda with product quality and operating efficiency equal or superior to any existing diaphragm cell operation.

Pennsalt's Michigan plant, located downriver from Detroit, is one of the Company's largest single manufacturing units encompassing both inorganic and organic chemical operations.

Pfaff Receives Appointment By Wheelabrator

Wheelabrator Corporation, Mishawaka, Ind., has announced that George O. Pfaff has been named Director of Marketing. Mr. Pfaff will continue to supervise Abrasive Sales and will be responsible for marketing the company's general products and Techline Division equipment and supplies.

His association with Wheelabrator began in 1953 with the Sales Promotion Department. Later, he became Manager of Standard Equipment Sales, and in 1956 he organized and directed the Abrasive Sales Division.

S. P. Kinney Promotes Two

S. P. Kinney, Engineers Inc., Carnegie, Pa., has announced the promotion of J. D. Morrow as Vice-President and Treasurer and H. B. Carr as Vice-President of Engineering.

Dickey Clay Expands

W. S. Dickey Clay Mfg. Co., Kansas City, Mo. has announced major expansion plans which include large scale projects in St. Louis, Mo. and Bessemer, Ala. New and enlarged facilities are expected to meet current needs and will assist in keeping pace with an expanding demand as well.

Completion of both projects in 1960 will coincide with Dickey's Diamond Jubilee Celebration, marking the company's 75th year as one of the leaders in the industry.

Contracts have been let for construction of a new straight line tunnel kiln in St. Louis. The complete unit, building and kiln will be completed and in operation early in 1960. This expansion, which augments a recently completed St. Louis plant addition, will increase the production of Dickey's St. Louis operation by 30,000 tons annually.

At Bessemer, Ala., plans for a new multi-million dollar plant have been finalized, and contracts have been awarded.

Texas Vitrified Promotes Kearby to Sales Mgr.

Texas Vitrified Pipe Company, Mineral Wells, Texas has announced the appointment of Don T. Kearby to the position of sales manager.

Kearby has been assistant sales manager since 1956. He joined the Tex-Vit organization in 1954 as a member of the home office sales department. Later he was assigned to customer sales contact work, and progressed into the responsibilities of field sales supervision.

A veteran of World War II, Kear-

CONTINUED ON PAGE 102A

McDONALD FOR OVER 100 YEARS

THE QUALITY NAME IN WATER WORKS BRASS GOODS

CORPORATION STOPS

4701 — With Straight Coupling Nut. (No Gasket).
Inlet: A.W.W.A. Corporation Stop Thread.
Outlet: Standard A.W.W.A. Thread for Copper Service Pipe.
Sizes: ½", ⅝" x ¾", ¾", 1", 1¼", 1½", 2".

4701

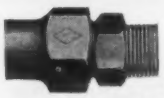
CURB STOPS – ROUND WAY – INVERTED KEY – COMBINED CAP AND TEE – WITH CHECK

4713

4713 — Stop
4714 — Stop and Drain. (Not Illustrated).
Inlet: A.W.W.A. Thread for Flared Copper Tube.
Outlet: A.W.W.A. Thread for Flared Copper Tube.
Sizes: ½", ¾", 1", 1¼", 1½", 2".

COPPER SERVICE PIPE FITTINGS

4753 — Straight Coupling.
Copper to Outside Iron Pipe Thread.
Sizes: ½", ½" x ¾", ¾", 1", 1¼", 1½", 2".


4753

4754 — Straight Coupling.
Copper to Inside Iron Pipe Thread.
Sizes: ½", ¾", 1", 1¼", 1½", 2".

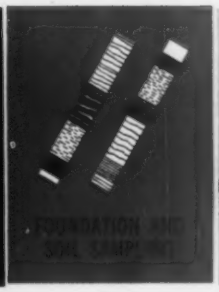
4754

For information on McDonald's complete line of quality Water Works Brass goods, write to:

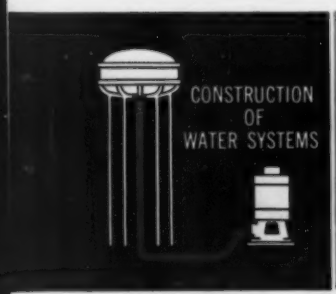
A. Y. McDONALD MFG. CO.
Dept. WSW-959, 12th & Pine Sts. Dubuque, Iowa

Layne

the only complete water service organization



Complete service means undivided responsibility



In an age of specialization there is a definite advantage in doing business with a company offering a COMPLETE SERVICE . . . providing *all* the services allied to the field of water.

Only Layne with its network of Associate Companies, and over 75 years of experience, all backed by Layne Research can offer its customers a complete water service which makes Layne unique in the industry.

World's Largest Layne *Water Developers*

LAYNE & BOWLER, INC., MEMPHIS

Offices and Factory • Memphis 8, Tenn.

LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

NEW CAMPAIGN STARTS COMMITTEES ACROSS

For the first time, a nationally organized plan to develop local action to combat our growing water shortage has been devised by a supplier to the industry. The need for a campaign to stimulate such action was recognized by the Cast Iron Pipe Research Association. Here's how the first year of the campaign was planned—and the successful results it produced.

Frank ads warned of shortage

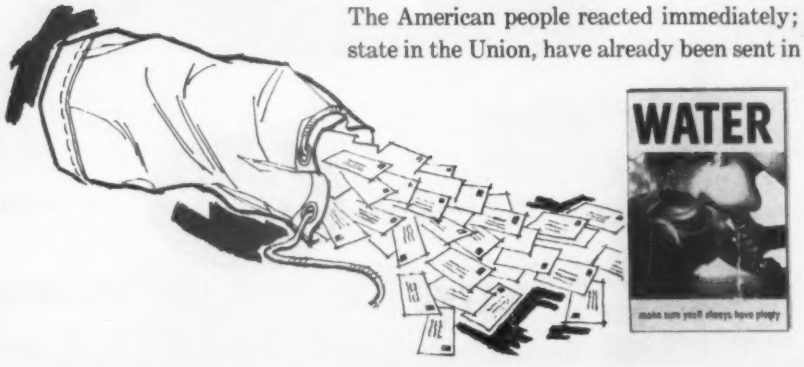
The theme of the ad campaign "What Will You Do Without Water?" was coupled with dramatic photographs of people using water in everyday situations.

Informative booklet told how <u>everyone</u> could help

Each ad offered the booklet "Water—Make Sure You'll Always Have Plenty," which outlined working plans for local action against water problems.

Response was heavy!

The American people reacted immediately; thousands of requests, from every state in the Union, have already been sent in for the booklet—but that's not all!



LOCAL WATER IMPROVEMENT THE COUNTRY!

Research shows people took action!

The average person who wrote in for the booklet did at least three things. For instance:

* He informed neighbors and friends of the problems, discussed solutions, and sought more information.
* He requested a starter kit from Cast Iron Pipe Research Association—to help spur more interest and plan new and better water facilities.
* He formed or joined a local water improvement committee in order to take direct and immediate action.

Here are just a few of the remarks received on the worth and completeness of the program.

From a housewife in Connecticut: *"Although I had no such intentions before, I'm going to do something about the suggestions given."*

From a teacher in the state of Washington: *"Last month I was elected as a trustee for the Local Water User's Corporation. We are now in the process of installing a new water reservoir; your program was a very helpful source of information."*

From a retired man in Florida: *"Our city is talking of putting in a new water supply system in order to tap river water. Your literature has been very useful."*

The American people are interested and willing to face the problem; they need only your guidance.

Now . . . A complete program for you!

A complete portfolio has been compiled for you—to help you stimulate action in your community . . . to help you answer some of your own local water problems. If you are now faced with a local water problem in which community relations will play an important part, write on your letterhead to the Cast Iron Pipe Research Association, 3440 Prudential Plaza, Chicago 1, Ill., Thos. F. Wolfe, Managing Director.

The Cast Iron Pipe Research Association is proud of the job it has done—and looks to the future with confidence that the American people can and will lick the water problem!

CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE

"Not a 'comeback' in 18 years" ...with Transite Sewer Pipe

says Anthony Garcia, President
Allerton Construction Co., New York

"In my eighteen years of installing Transite sewer mains and house laterals, I have never had a 'comeback' because of line failures. Most of the installations have been 100% under water. Therefore, tight joints that stay tight are absolutely essential! For these reasons Transite has always been my choice for sewer line service. I never worry about passing leakage or infiltration tests. I play it safe —with Transite."

You'll want to read how Johns-Manville Transite® Pipe has helped other contractors increase their profits and productivity . . . in the informative and interesting new, 8-page booklet, TR-206A. Send for it now! Address Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE JOHNS-MANVILLE JM PRODUCTS

How to support America's Peace Power with each Christmas Bonus

If your Company is now planning employee Christmas gifts or year-end bonuses, why not make each remembrance a gift of thrift—with U. S. Savings Bonds? Every Bond you give contributes to our nation's Peace Power; it represents for the man or woman who receives it, a tangible Share in America.

By installing and promoting the Payroll Savings Plan for U. S. Savings Bonds you can offer your employees a welcome year-round gift.

Contact your State Savings Bond Director for information about the new 3¾% Series E Bonds and for Payroll Savings materials and assistance. Or write to the Savings Bonds Division, U. S. Treasury Department, Washington 25, D. C.

THE U.S. GOVERNMENT DOES NOT PAY FOR THIS ADVERTISEMENT. THE TREASURY DEPARTMENT THANKS, FOR THEIR PATRIOTISM, THE ADVERTISING COUNCIL AND THE DONOR BELOW.

WATER & SEWAGE WORKS

16 concrete specials make tough job easier

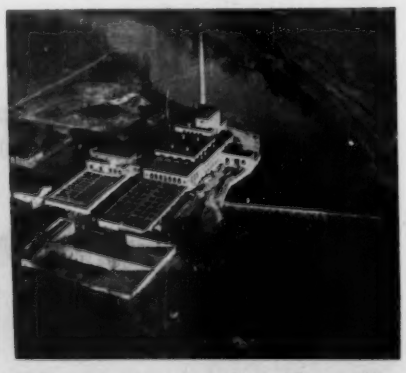
If you've ever added a new head house and new clarifiers to a water treatment plant, you know that the piping job isn't easy. It's tough to design and install.

But Malcolm Pirnie Engineers of New York designed 16 specials in five pipe sizes (from 20 to 42 inch) and Contractor Ivor J. Lee of Sharon put the job in without a hitch for the Shenango Valley Water Company, Sharon, Pa.

The prestressed concrete steel cylinder pipe like that used on this job can be designed for any project, easy or tough. If you want to know more about it, write our headquarters plants at Hattiesburg, Miss., or Dayton, Ohio.

Price Brothers

Workmen installing T's and short lengths to tie new piping into existing 36-inch settled water line.

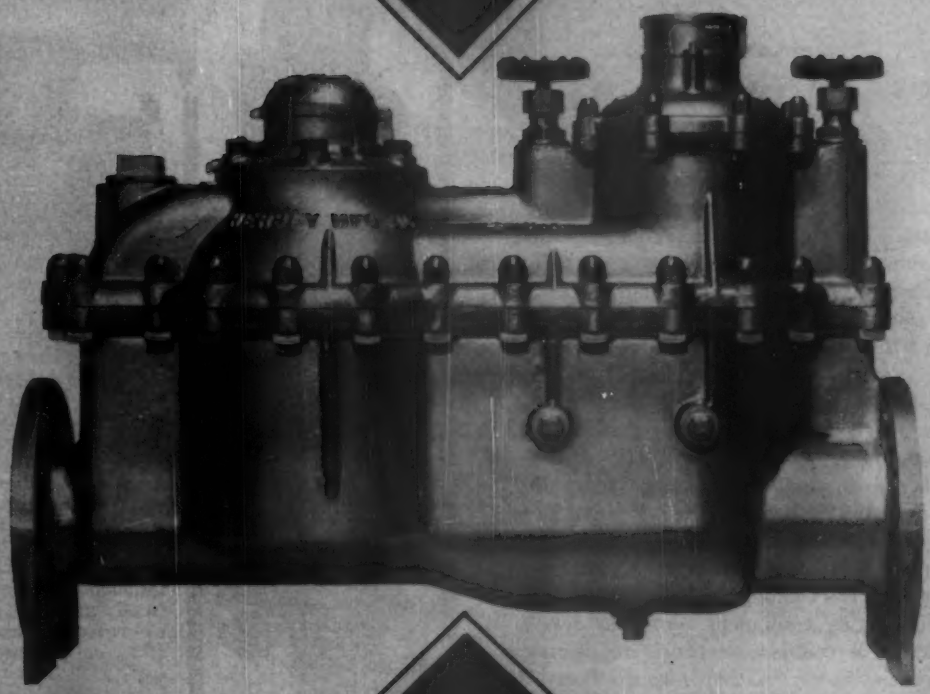


Specials (left) and short lengths (center) simplify installation at Shenango Valley Water Company treatment plant, Sharon, Pa.

HERSEY COMPOUND METERS

ALL BRONZE CASE 2" to 6" INCLUSIVE

Of course they are the best!
Specified by experienced water works officials in all fifty States



HERSEY 1859 1959 100 YEARS OF PROGRESS

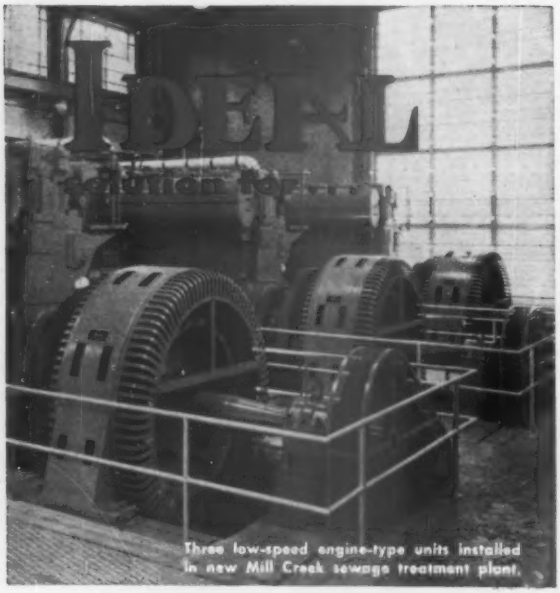
HERSEY MANUFACTURING COMPANY

(Established 1859)

DEDHAM, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA
DALLAS — CHICAGO — SAN FRANCISCO — LOS ANGELES

YOU CAN'T BUY A BETTER WATER METER THAN HERSEY



Three low-speed engine-type units installed in new Mill Creek sewage treatment plant.

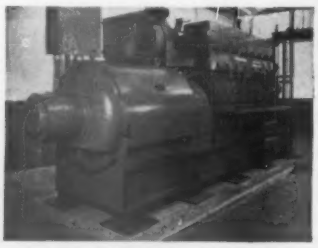
ideal performance at mill creek

Three IDEAL 1350 kw generators, coupled to 1910 hp diesels, turn at 327 rpm to provide power for pumping, comminution, flocculation, digestion and building lighting at Cincinnati's new Mill Creek Sewage Works. A fourth unit, to be installed prior to completion of the facility, will provide a total capacity of 120 million GPD. It's another example of IDEAL equipment selected for outstanding municipal power development projects where dependable power performance is important.

On the job in similar installations across the land and around the world, IDEAL low and high speed generators in ratings from 10 to 10,000 kw are designed and engineered to meet your exact requirements. You can depend on IDEAL's reputation for quality equipment earned in over a half-century of creative electrical engineering. When your specs say "IDEAL", it's the finest!

EMERGENCY STAND-BY

Typical high-speed unit installed on a diesel generating set in a Midwestern metropolitan telephone exchange. 50, 60 and 400 cycle, 10 to 4000 kw for any requirement.



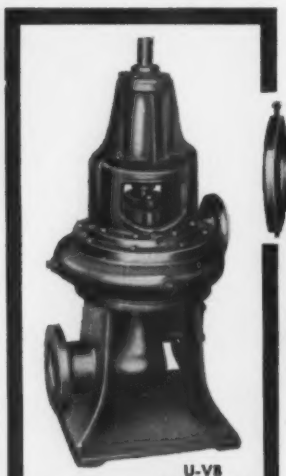
The IDEAL ELECTRIC & MANUFACTURING CO.
323 East First St. Mansfield, Ohio

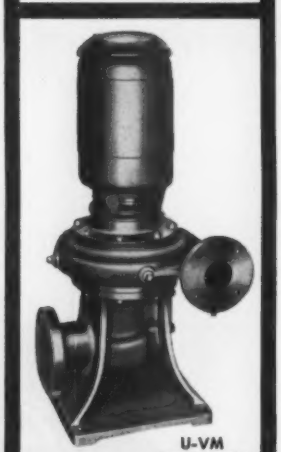
SINCE 1903, AMERICA'S FINEST MOTORS, GENERATORS, MOTOR-GENERATOR SETS, SWITCHBOARDS AND CONTROLS

WEINMAN

vertical non-clog pumps handle sewage efficiently, need little space

U-VBM
Bulletin 1600


U-VB
Bulletin 1610


U-VM
Bulletin 1410

Weinman Type U-VBM pumps need less than half the floor space used by conventional horizontal sewage ejectors of equal capacity. The motor, elevated above the pump, needs no additional floor space nor flexible shafting.

Other advantages of these pumps are their reasonable initial cost, low installation cost and practically maintenance-free operation. When floor space is at a premium, specify Weinman vertical Type U-VBM pumps. They easily handle liquids, sludge or suspended solids without clogging. Their low suction, powerful operation meet toughest requirements.

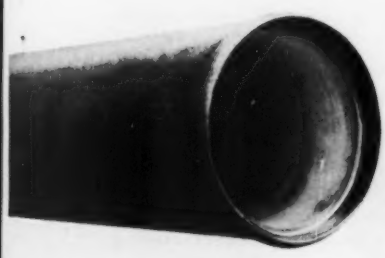
50th Anniversary 1909-1959

Write us for Bulletins which give complete information and specifications. Or, call your Weinman pump specialist. He's listed in the Yellow Pages.

THE WEINMAN PUMP MFG CO.
290 SPRUCE ST. COLUMBUS 8, OHIO

CENTRIFUGAL SPECIALISTS

EXTRA SAFETY FACTOR!



CONSERVATIVE DESIGN is one of the important reasons why American Concrete Cylinder Pipe has gained such high acceptance by engineers and water works officials in the west. The composite design of the pipe is based on a factor of safety of 2¼ at the elastic limit of the pipe. American Concrete Cylinder Pipe will safely withstand sudden and severe increases of pressure – surge and water hammer – or the occasional concentrated external loadings met under unusual field conditions.

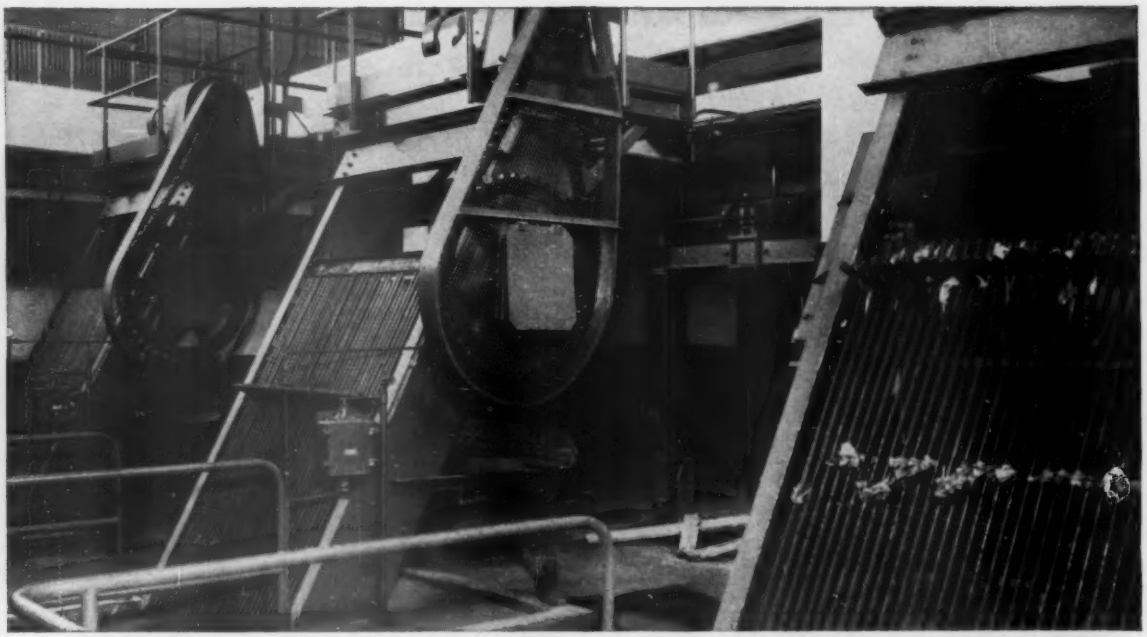
The *composite* action of the mortar lined steel cylinder, circumferential rod reinforcement and external mortar coating accounts for the consistently successful performance record of this type of pipe. The use of a minimum of 25% to, under certain conditions, 50% or more of the total required cross-sectional steel area as tension-wound circumferential reinforcement substantially increases the pipe's external supporting strength over that which would be obtained if all of the required steel area were placed in the cylinder alone.

Take advantage of American Concrete Cylinder Pipe's greater inherent strength through more effective use of materials – see an American sales engineer when planning your next project.

CONCRETE PIPE FOR MAIN WATER SUPPLY AND TRANSMISSION LINES

American PIPE AND CONSTRUCTION CO.

LOS ANGELES: 4635 Firestone Blvd., South Gate, Calif.— LOrain 4-2511 • **HAYWARD:** P.O. Box 630 — JEfferson 7-2072 • **SAN DIEGO:** P.O. Box 13 — CYpress 6-6166 • **PORTLAND:** 518 N.E. Columbia Blvd. — BUtler 5-2531 • **ALBUQUERQUE:** P.O. Box 1782 — CHapel 7-0486 • **PHOENIX:** American Concrete Pipe Co. (Subsidiary) P.O. Box 12127 — Alpine 2-7566



No jamming at bottom of screens *with mechanically back-cleaned Jeffrey Bar Screens. Rake lifts off accumulated screenings as the flow enters bars.*

Again... Bowery Bay Plant chooses Jeffrey sewage treatment equipment

Confidence in the efficiency and reliability of Jeffrey sewage treatment equipment resulted in its use in the original 40 mgd Bowery Bay Plant... when the World's Fair triggered New York City's long range attack on harbor pollution. Selection of Jeffrey Bar Screens and Collectors for the recent big extension of plant capacity (now 120 mgd) testifies to the performance record of the 18-year-old Jeffrey equipment.

Jeffrey Collectors *were specified for 6 primary settling tanks and 8 final tanks added at Bowery Bay. Under ordinary conditions, mechanical disturbance can be limited to less than 1 hour in 24, due to large carrying capacity.*

Jeffrey Bar Screens—Nine of these mechanically back-cleaned bar screens have been added to facilities at Bowery Bay. Rakes enter from discharge side and project through bars as they travel from bottom toward headshaft. Screenings are carried over the top and drop off as rakes leave the screen bars.

If screenings accumulate rake lifts them off as it enters the bars. This action virtually eliminates jamming at the bottom of the screen.

Primary and Final Settling Tanks—Rectangular tanks, equipped with Jeffrey Collectors, have proved to be the most efficient sedimentation device ever designed. Stable conditions of flow make possible maximum solids removal in tanks of minimum size. Simplicity and ruggedness of Jeffrey Collectors assure long life and trouble free operation.

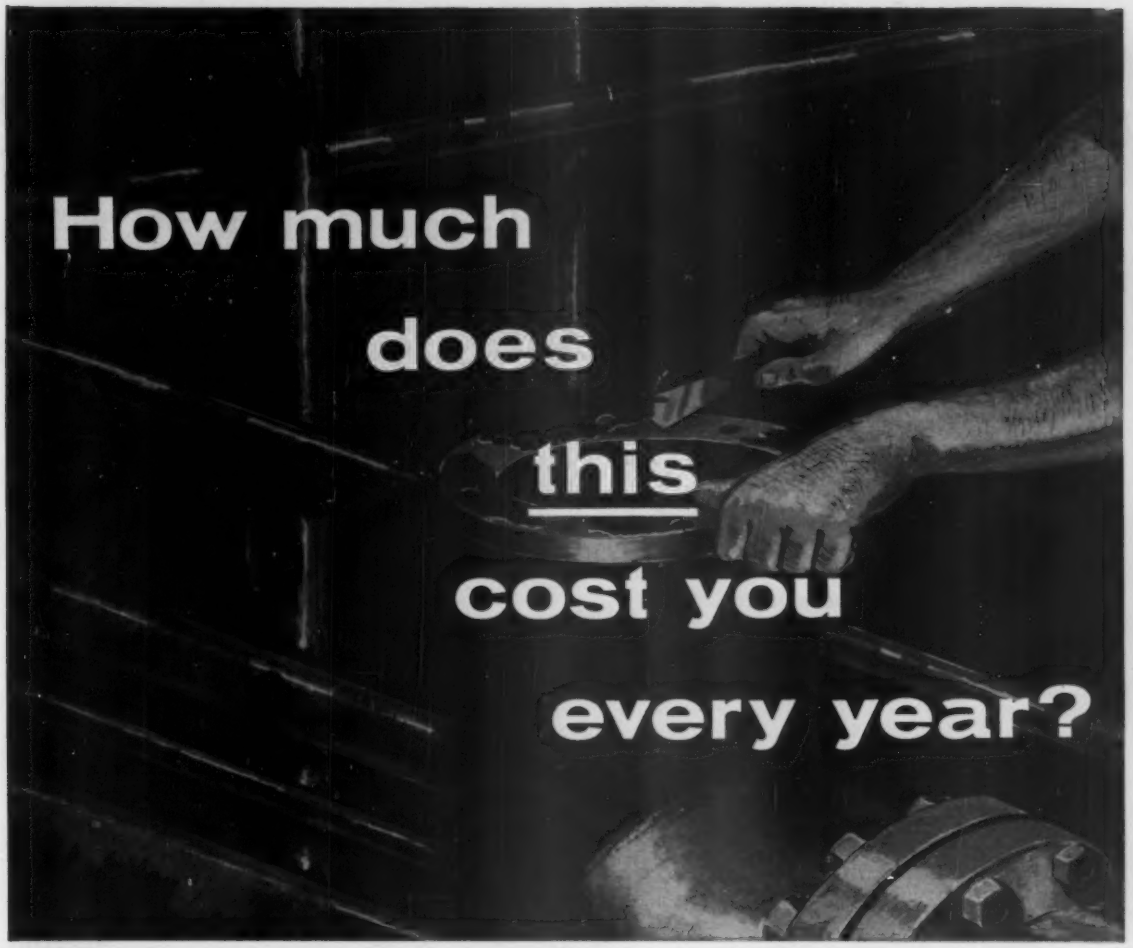
Large carrying capacity of Jeffrey Collectors permits intermittent operation... significant power savings, a thicker sludge and clearer effluent.

Once you review the facts on the design efficiency and quality of Jeffrey equipment for water, sewage and industrial waste treatment, you'll see why so many important projects specify Jeffrey. Send for Catalog 905, The Jeffrey Manufacturing Company, 996 North Fourth Street, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT...TRANSMISSION MACHINERY...CONTRACT MANUFACTURING

Maintenance Cost Too High?



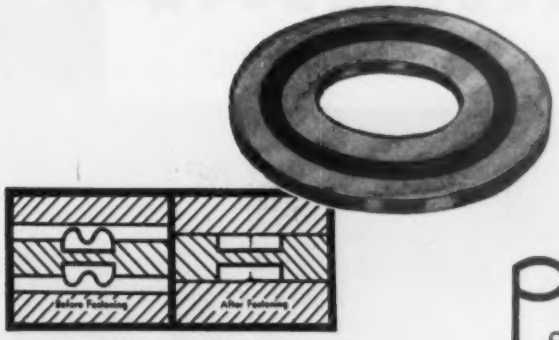
How much time, effort, and money is spent cleaning, resurfacing and/or replacing flanges to replace the seal!

Expensive? Yes!

Why not find out about Gask-O-Seals and save! Here are the facts: With Gask-O-Seal, flange faces require little or no cleaning or resurfacing of flanges when replacing the seal — *and Gask-O-Seals are re-usable.*

Gask-O-Seals save money and effort in many other ways, too. They are visually inspectable, do not need to be re-torqued, there is no material creep and they are non-directional, non-flexible, easy to install. They provide no-leakage sealing, *can not blow out,* and there is no wear due to pulse.

Now available to fit ASA standard flanges. Write for free catalog.

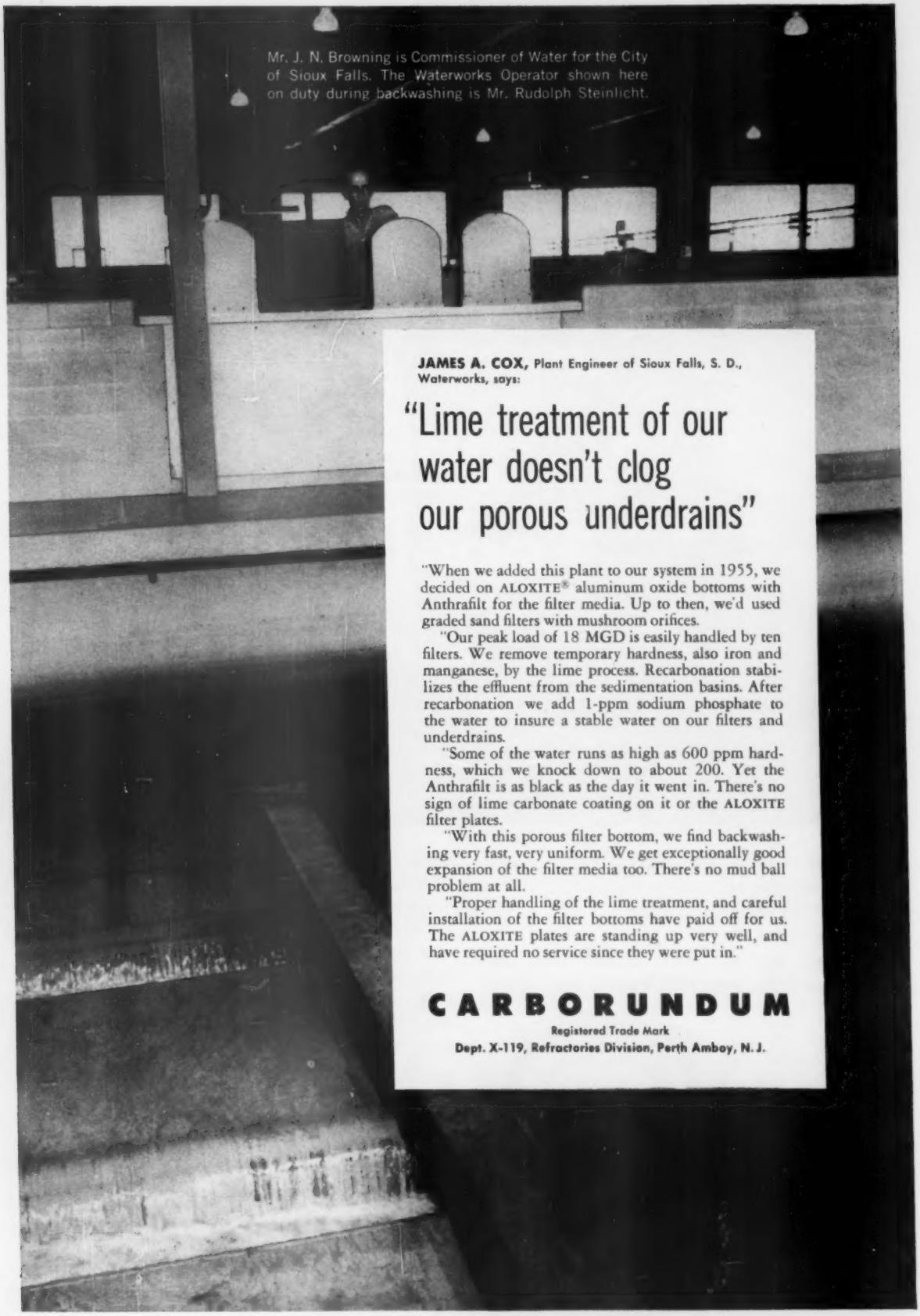


Note metal to metal contact.

Parker SEAL COMPANY

CULVER CITY, CALIFORNIA and CLEVELAND, OHIO

A DIVISION OF PARKER-HANNIFIN CORPORATION



Mr. J. N. Browning is Commissioner of Water for the City of Sioux Falls. The Waterworks Operator shown here on duty during backwashing is Mr. Rudolph Steinlicht.

JAMES A. COX, Plant Engineer of Sioux Falls, S. D., Waterworks, says:

"Lime treatment of our water doesn't clog our porous underdrains"

"When we added this plant to our system in 1955, we decided on ALOXITE® aluminum oxide bottoms with Anthrafilt for the filter media. Up to then, we'd used graded sand filters with mushroom orifices.

"Our peak load of 18 MGD is easily handled by ten filters. We remove temporary hardness, also iron and manganese, by the lime process. Recarbonation stabilizes the effluent from the sedimentation basins. After recarbonation we add 1-ppm sodium phosphate to the water to insure a stable water on our filters and underdrains.

"Some of the water runs as high as 600 ppm hardness, which we knock down to about 200. Yet the Anthrafilt is as black as the day it went in. There's no sign of lime carbonate coating on it or the ALOXITE filter plates.

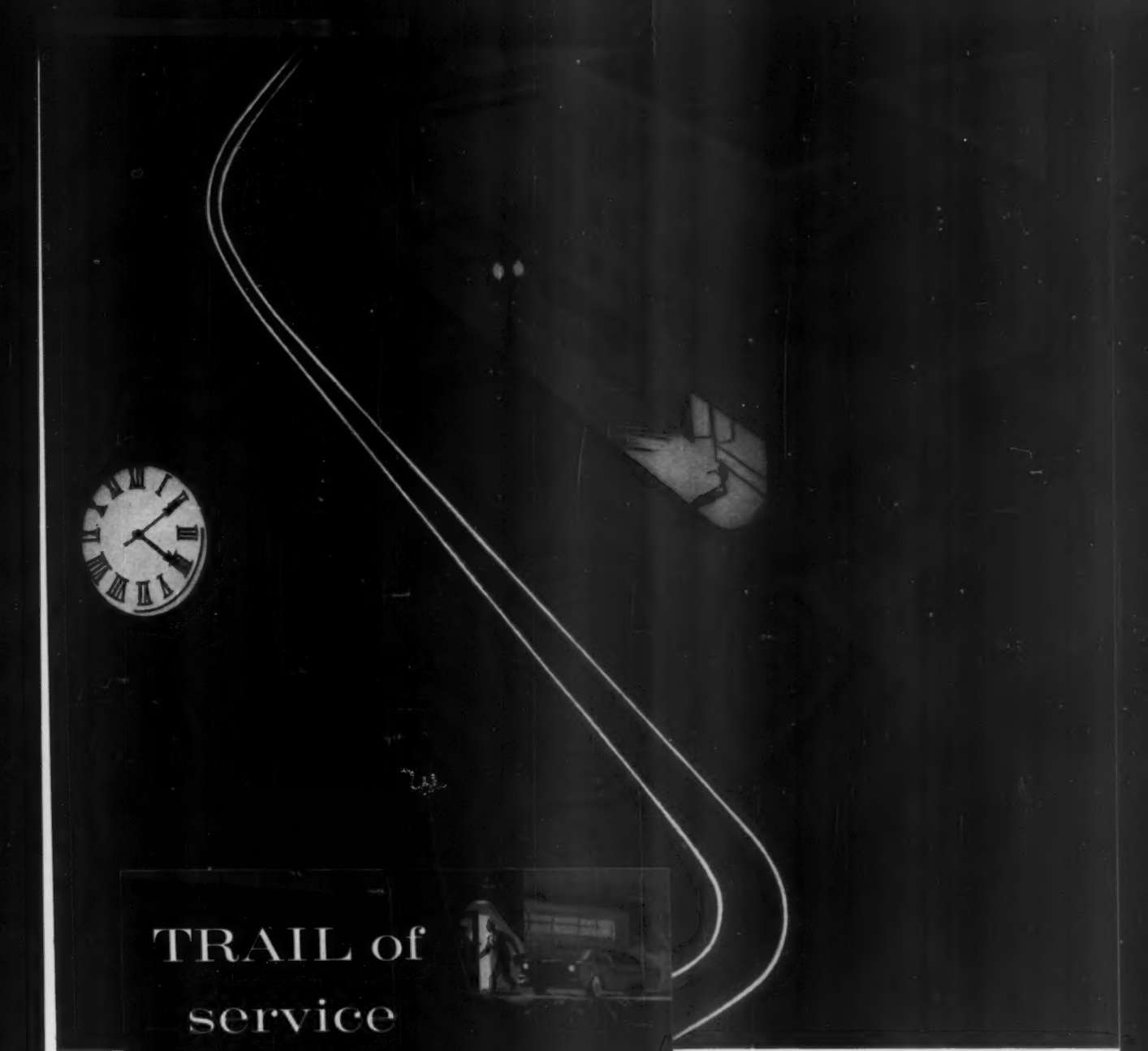
"With this porous filter bottom, we find backwashing very fast, very uniform. We get exceptionally good expansion of the filter media too. There's no mud ball problem at all.

"Proper handling of the lime treatment, and careful installation of the filter bottoms have paid off for us. The ALOXITE plates are standing up very well, and have required no service since they were put in."

CARBORUNDUM

Registered Trade Mark

Dept. X-119, Refractories Division, Perth Amboy, N. J.



TRAIL of service that never sleeps

Products for industry: electrical generation, distribution and utilization equipment; pumps; compressors; mechanical power transmission equipment; processing machinery; motors and control; water conditioning systems, plus materials handling equipment.

Backing up the broad line of Allis-Chalmers products are more than 200 field installation and service men. Available day or night, they respond promptly to the emergency needs of A-C customers.

Hundreds of other facilities, strategically located, guarantee lifetime service support to Allis-Chalmers products wherever they are applied.

Regional Offices are located in key industrial cities.

District Offices across the country cover every city or area wherever Allis-Chalmers equipment is used.

Certified Service Shops are only minutes away for expert round-the-clock service.

Warehouse Stocks are within easy reach of all these service teams for fast delivery.

Ask your A-C representative about this coast-to-coast service organization, and the lifetime service support behind every A-C product, or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-1198-G1

Mayor R. Dewey Stearns says...

"Saginaw's modern water system pays for itself 365 days a year!"

"Good, fresh water—with its quality protected by miles of Transite Pipe—helps make Saginaw, Michigan, a wonderful place to live . . . work . . . and do business!"

"Busy shoppers in downtown Saginaw give an accurate indication of the active business climate our citizens enjoy . . ."

"Diversification is important to our economy. And each industry —from automotive products and heavy machinery to baking equipment, precision instruments and agriculture—*thrives on water* . . ."

"Because good water is vital to the life and growth of Saginaw, we go to one of the best raw water sources in the Midwest . . . to Lake Huron for a limitless supply of the finest and purest water."

"A water system must undergo continuous expansion to meet growing domestic, industrial and fire protection needs. Transite Pipe has helped Saginaw expand economically and efficiently since we first used it in 1933."

J-M Transite Pipe safeguards water purity... helps keep its cost low!

Made of tough, durable asbestos-cement, Transite® Pipe cannot rust . . . stays clean to protect the quality and purity of the water it carries!

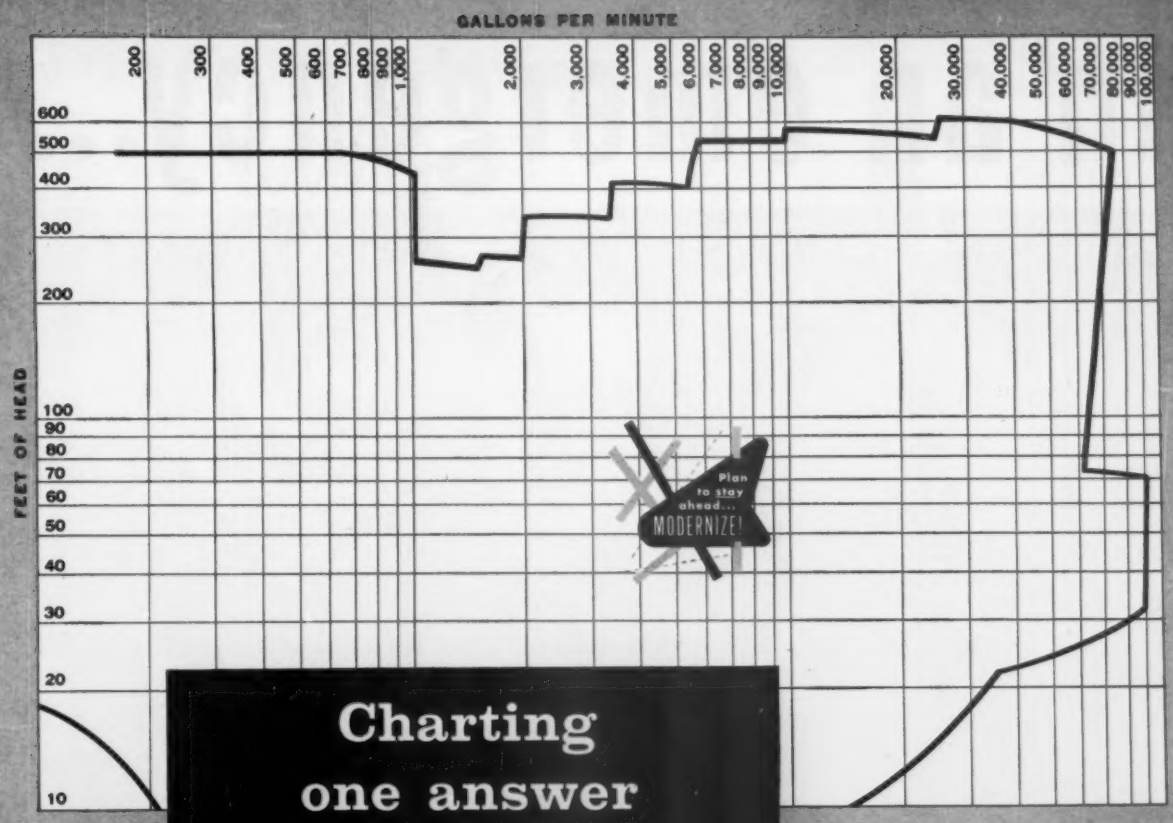
Transite also saves tax dollars for other uses—it is installed quickly, economically . . . its smooth interior keeps pumping costs low . . . its Ring-Tite® Coupling conserves precious water. And, of course, Transite Pipe is noted for its unusually long life.

For information on how Transite Water Pipe (and Transite Sewer Pipe, too) can serve your city write Johns-Manville, Dept. N-9, Box 14, New York 16, N.Y.

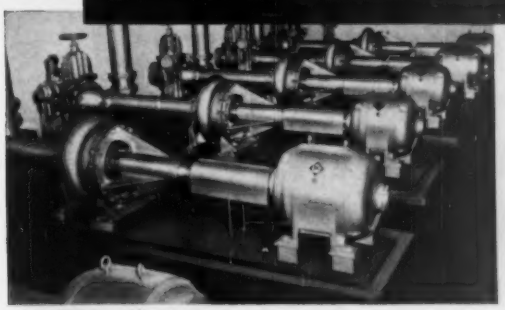
Your prosperity, welfare, safety, depend on good water . . . and plenty of it. Now is the time to support your water program . . . and water utility officials.

JOHNS-MANVILLE

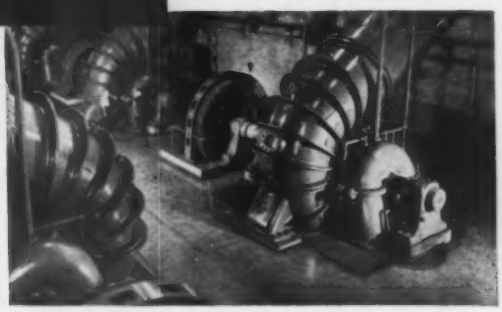
JOHNS-MANVILLE JM PRODUCTS



Charting one answer for every pumping need



Auxiliary service is the job for six 10 x 8 A-C pumps. They are driven by Allis-Chalmers motors.



Main station application involves 12 A-C 72-inch Type SP pumps like that shown.

From the smallest auxiliaries to giant, main system pumps, the range chart for Allis-Chalmers pumping units covers practically every public works requirement. This outstanding one-source equipment availability is a good reason why A-C should be given "first call" in modernizing the pumping facilities of your municipal system.

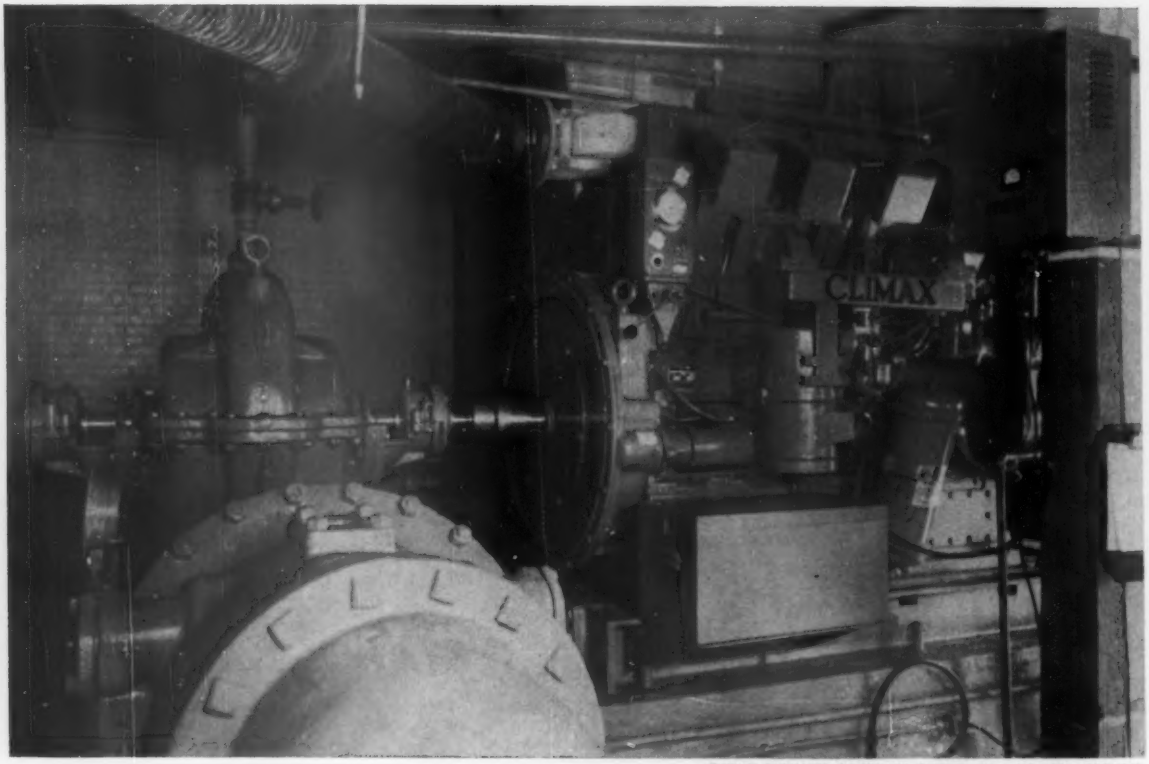
And complete line is only one "plus" for Allis-Chalmers. Teamed motors and control; customized standardization of parts and materials; engineering assistance and nationwide service are others.

Whatever your need in centrifugal pumps (and A-C builds units even beyond the chart shown), contact your representative or distributor. For additional information, write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-1023-PW

in an emergency...



ENGINE INSTALLED BY POWER SERVICE CO., ATLANTA, GEORGIA

in case of fire and power failure

CLIMAX V-85 ENGINE DRIVES PUMP

to protect the Georgia Division Plant of LOCKHEED AIRCRAFT CORPORATION

The largest aircraft plant under one roof in the United States—Air Force Plant No. 6 at Marietta, Georgia—is operated for the Air Force by Georgia Division of Lockheed Aircraft Corporation to build C-130 Hercules Cargo-Troop Carriers. Here—ready for emergency—is a Buffalo 10″ Class S double suction pump with 22½″ diameter impeller, driven by a V-85 Climax 390 hp engine. With its minimum capacity of 4500 gpm at 100 psi discharge head, this unit will go into action pumping water in the event of fire and a power failure. The V-85 Climax Engine—8-cyl., 60° V-type, 7½-in. bore x 7-in. stroke, 2474 cu. in. displ.—burns butane or natural gas. Fuel economy is built in. The unusual compactness of Climax V-8 design means more power packed into less space. Rugged, too, for durability with dependability in continuous duty utility plant pumping and generator service. For all its plus-value features get Bulletin SA-584.

CL-110

CLIMAX ENGINE MANUFACTURING CO. • DIVISION OF WAUKESHA MOTOR COMPANY
FACTORY—CLINTON, IOWA

install valves *without* interrupting service!

You can add needed gate valves anywhere in your water system—without a shut-down—when you use **MUELLER®** Inserting Valves. These valves are specifically designed to be quickly, easily installed in any existing 4″, 6″ or 8″ cast iron main under full service pressure. There is no loss of water, no interruption of service and no loss of fire protection.

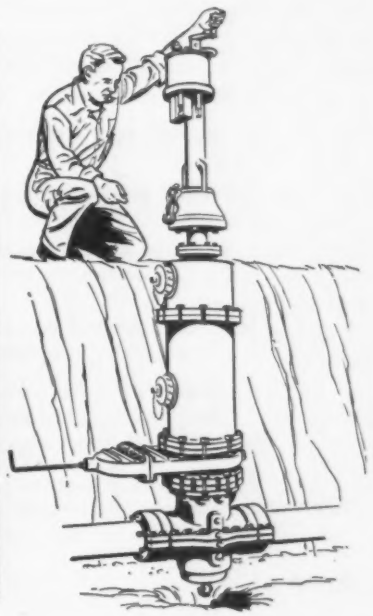
The gate valve mechanism of the Mueller Inserting Valve is identical to that of dependable Mueller AWWA Gate Valves and Mueller Tapping Valves. This permits standardizing on one type of valve mechanism for all your valve needs.

This product feature is typical of the attention to detail in research, design and engineering that becomes a part of every Mueller product produced for the water works industry.

here's how with Mueller Inserting Valves

1. Bolt sleeve halves to main and calk end joints.

2. Cut out section of main with Mueller Drilling Machine.



3. Lower valve plug assembly into main and secure.

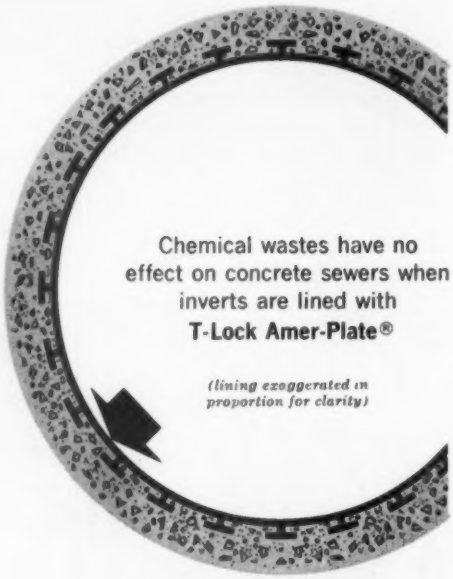
MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles;
In Canada: Mueller, Limited, Sarnia, Ontario

How to Protect Concrete Sewers from Chemical Wastes

T-Lock Amer-Plate is a high polymer PVC sheet, easily cast into pipes, tunnels and structures to form a partial or complete 360° protective lining. Used in inverts, it permanently protects concrete from corrosive chemical effluents. In arch areas, it positively stops oxidized H_2S corrosion. T-Lock is also highly abrasion resistant; impartial tests show that it abrades at only 1/70th the rate of concrete.

The fact that T-Lock ends erosion and corrosion problems in industrial and municipal sewer systems is attested to by more than five million square feet now in use.


Chemical wastes have no effect on concrete sewers when inverts are lined with
T-Lock Amer-Plate®
(lining exaggerated in proportion for clarity)

WRITE FOR THIS FREE DATA

Any of the following printed pieces may be obtained without obligation by writing to Amercoat Corporation at the address shown below. Perhaps the information contained will prove helpful to you when designing your next sewer.

BROCHURE: T-Lock Amer-Plate, locked-in protective lining for concrete pipe, tunnels and structures.

LIST: Sewers in which T-Lock Amer-Plate has been installed, including names of purchasing bodies, locations, dimensions and dates.

REPRINT R-6: Wichita's new sewer is plastic lined to protect concrete from sulfide gas (Kansas Construction Magazine).

REPRINT R-7: How T-Lock was applied to a cast-in-place concrete sewer tunnel (Engineering News-Record).

REPRINT R-10: How City of Los Angeles protects new sewer against corrosion (Water & Sewage Works and Public Works).

REPRINT R-15: Try these tricks for faster lining of sewer tunnels (Construction Methods & Equipment).

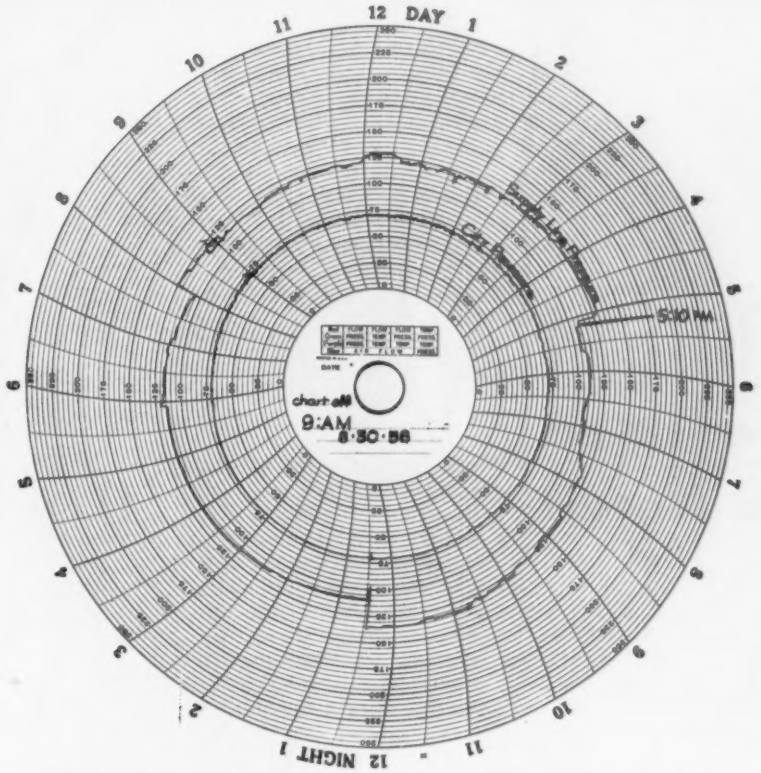
Applicators strategically located throughout U. S. and Canada

Amercoat® CORPORATION

Dept. WL • 4809 Firestone Boulevard
South Gate, California

• 921 Pitner Avenue • Evanston, Illinois
• 360 Carnegie Avenue • Kenilworth, New Jersey
• 2404 Dennis Street • Jacksonville, Florida
• 6530 Supply Row • Houston, Texas

118 A



Actual pressure recording meter chart shows how City pressure remains constant despite variations in supply line pressures over a 24-hour period. **EXAMPLE:**

Time	Supply Pressure	Flow Rate	City Pressure
5:00 p.m.	135 psig	8.9 MGD	70 psig
5:10 p.m.	105 psig	15.0 MGD	70 psig

Commissioner Hugh Brewer says: "We are pleased with the continuous, dependable service of these Rotovalves."

"They are the best control valves I ever saw," testifies Water Superintendent John Luce.

Ft. Smith Relies On Allis-Chalmers ROTOVALVES *For*
CONSTANT WATER PRESSURE

Since 1949, the City of Fort Smith, Arkansas, has used Allis-Chalmers Rotovalves exclusively on pressure regulating service. Two 16" hydraulically-operated Rotovalves, installed on a 23-mile gravity supply line from the filter plant to the City, have given uninterrupted service. City water pressure remains constant regardless of supply line pressures or rate of flow (demand) in the system.

Manually-operated A-C Rotovalves are also installed in Ft. Smith's transmission and distribution mains. In the event of an emergency, hydraulic imbalance and mechanical design of these valves permit fast, easy operation by one man. Rotovalves installed by the Ft. Smith Water Department have a perfect service record with only nominal maintenance.

There is a full line of Allis-Chalmers Rotovalves, ball and butterfly valves to meet all requirements in water service. For complete information, call your A-C valve representative, or write Allis-Chalmers, Hydraulic Division, York, Pennsylvania.

Rotovalve is an Allis-Chalmers trade name.

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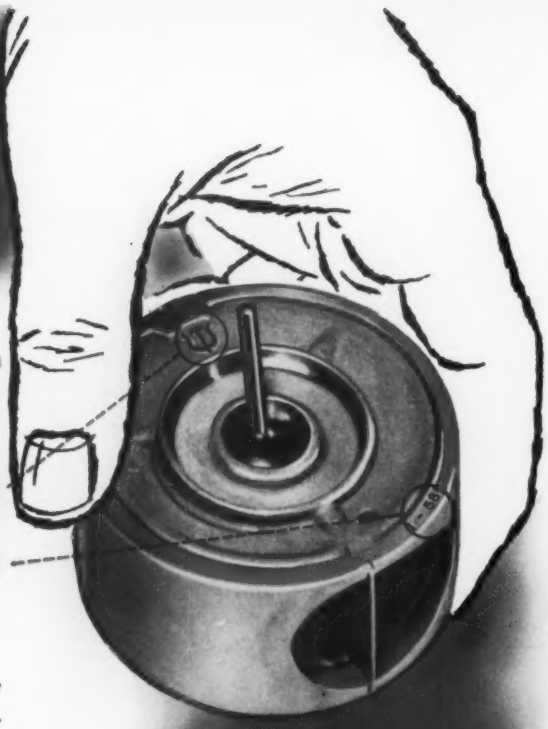

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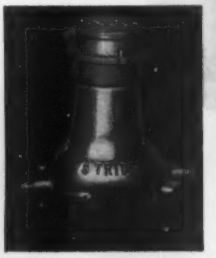

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TRIDENT WATER METERS

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WATER & SEWAGE WORKS

The effect on water and sewage systems of the movement to the suburbs is typified in the . . .

Explosive Growth of a District

by V. A. VASEEN, Pres.
Ripple & Howe, Inc.
Denver, Colo.

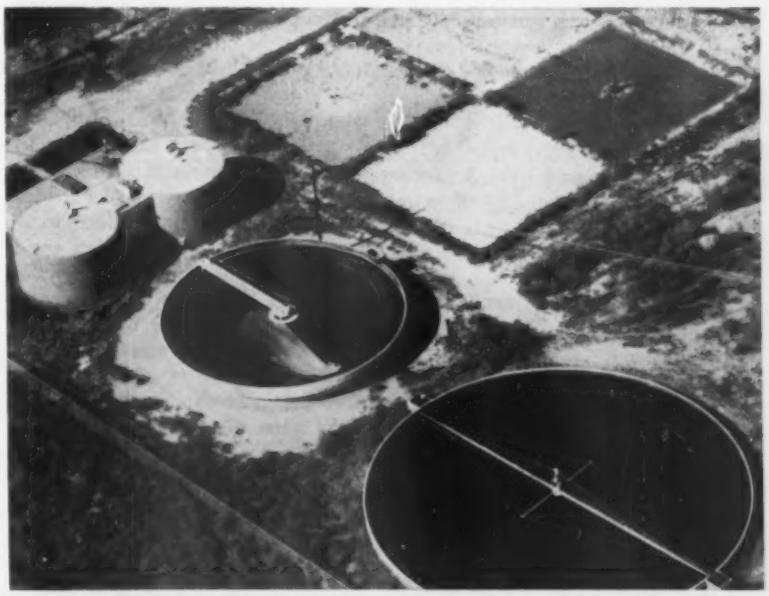
EDITOR'S NOTE: Begun in 1951 to provide sewerage and sewage treatment for an area of one hundred acres outside of Denver the North Washington Street Water & Sanitation District in less then eight years found itself with an area of eight square miles, 500 water consumers and a 4 mgd water softening plant as well as the sewer system and sewage treatment plant. It also found itself expecting to have five times as many customers as it now has within the next few years. This is the typical pattern of suburban development in this country today. How the district kept pace with this rapidly expanding situation is told here by the President of the firm which acted as consulting engineers to the District.

■ THE NORTH WASHINGTON Street Water & Sanitation District was organized in 1951, principally for the purpose of providing sewage disposal for a small area of approximately 100 acres just north of the City and County of Denver which is lower in elevation than the Denver sewage treatment facilities. Following the organization of the District, further studies showed it to be of considerable advantage to expand the District's boundaries north approximately three miles to encompass a community known as Welby, Colorado which is approximately one mile north of Clear Creek. The area covered by the District then included the lower portion of a natural drainage channel, approximately four miles in length, north and south, on the west bank of the South Platte River, and about two miles in width with an artificial boundary, a new express way, known as the Boulder-Denver Turnpike as its west boundary.

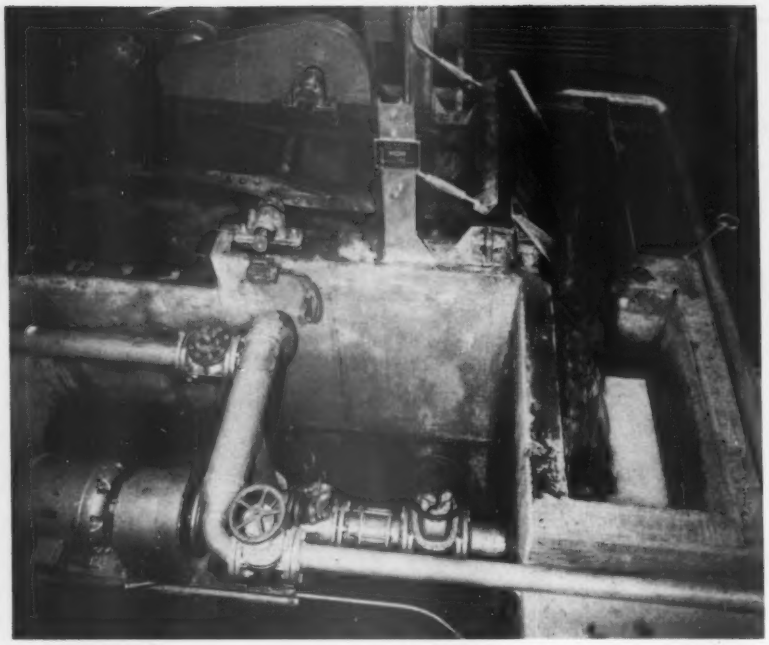
Sewer System

In 1953, $410,000 in bonds were voted for the purpose of constructing sanitary sewers throughout the major portion of the area and a sewage treatment plant of approximately 1 mgd capacity. The bond election was successful and 54,200 ft of sanitary sewers were installed. The sewage treatment plant was constructed at the confluence of Clear Creek and the Platte River. A more ideal location for a treatment plant would be difficult to find as it placed it in position to receive sewage from an area reaching several miles both north and south and theoretically for some 20 miles to the Rocky Mountains on the west.

The Sanitation District started its facilities in November 1954 with approximately 80 per cent of the design hydraulic load which is a flow in the order of 0.8 mgd. About 80 per cent of this flow is high BOD wastes from a group of industrial plants. These industries are: a National Foods packing plant and the Alterberger Packing Plant each killing approximately 200 steers per day, the Zenith Packing Plant slaughtering about 20 head a day, the Dorffler Horse Meat Packing Plant handling around 30 horses per day and the Princeton Dairy pasteurizing and bottling approximately 1000 gallons of milk each day. The average BOD of the raw sewage varied from 800 to 1200 mg/1. Sampling of the raw effluents of these various plants as they discharged to



THE NORTH WASHINGTON Street Water & Sanitation District Sewage Treatment Plant



BAR SCREENS at the sewage treatment plant

the Platte River was attempted prior to the design of the plant, so that a general idea of the strength and flow would be available. At best, the information obtained was insufficient to be of use in the preparation of the final design.

Treatment Plant

The sewage treatment plan was constructed with a disintegrator and bar screen followed by a wet pit containing two 500 gpm vertical wet pit pumps lifting all the sewage approximately 30 ft, including friction head, to the primary clarifier. The primary is 65 ft in diameter by 7.5 ft side wall depth. The tank is concrete and a grease skimmer was provided. Sewage then drains from the clarifier by gravity to a high-rate bio-filter 100 ft in diameter with a stone depth of 4 ft. Following the filter, the sewage is proportioned so that sufficient filter effluent is allowed to drain back to the raw sewage wet pit and be pumped back through the plant to provide 1:1 recirculation on the filter. The plant effluent is lagooned and then allowed to drain to the Platte River. Two heated digestors each 30 ft in diameter by 25 ft SWD equipped with draft tube risers are provided for sludge treatment. Sludge is recirculated by a horizontal 150 gpm non-clog open impeller pump.

District Growth

Immediately following the installation of the sanitary sewer system, the City of Thornton, Colorado now a community in excess of 12,000 people was started at the north boundary of the sanitation district. This opened an area of approximately eight and one-half square miles between the City of Denver on the south and Thornton on the north to industrial, commercial and residential development. Considerable pressure by various interests was brought on the Board of Directors of the District to activate itself as a Water District as well as a Sanitation District. The subdivision activity was in the north half of the District, which made it difficult to sell the bond issue necessary to make a water system available for subdividers to the various gardeners and the few residential residents of the District. In April 1955, the author's firm prepared a comprehensive water report for the Board of Directors, indicating the expected growth rates as well as the other pertinent data on the potential of the water district. Although many avenues were explored by the District in attempting to find a means of providing the water system, it was not until May 1956 that the work was successful. At that time the P-C Enterprises Company and the District came to an agreement under which P-C Enterprises agreed to construct approximately $200,000 worth of water facilities to be owned by them until such time as the District was financially able to purchase the construction from revenues. The District agreed to operate and maintain the system through the period of lease, which was estimated to be between 3 and 4 years. Specifically, P-C Enterprises agreed to construct a main water line from the source of supply to the principal area of subdivision. They also agreed to construct sufficient shallow wells to provide a maximum of 1 mgd of water for the system, as well as a control and booster pump house, a 1 mil gal storage reservoir, and to purchase approximately three acres of land for the development of the raw water facilities.

Water System Construction

In May 1956, the contract for phase one of the project was let. This contract called for 10,000 ft of 10 in. pipe; two shallow wells, approximately 24 ft deep, with a 125 gpm, 355 ft total dynamic head pump for one well, and a 250 gpm, 355 ft total dynamic head pump for the second well, as well as an automatic chlorinator. During the construction of the two shallow wells it was found the type of aquifer encountered was pocketed with tight sands and that better water production would be obtained from the construction of an infiltration gallery. Consequently, 290 ft of perforated tile, 24 in. in diameter was laid on a 6 in. gravel bed on top of the shale, approximately 24 ft from grade, and then covered with the sandy material found at the site. The 290 ft was found to produce in excess of 700 gpm thus providing the 1 mgd sought for the original development.

Phase Two

A further requirement of the agreement between P-C Enterprises and the District was that the P-C Enterprises Co. would construct at the 149th connection to the water system, the balance of the construction. However, the growth of both the water and sanitation system was so rapid that in October, 1957 with approximately 120 connections, P-C Enterprises authorized receiving of bids on the balance of the work. Contracts were let in January 1958 for a 1 mil gal concrete prestressed reservoir to be built at a cost of $48,808. Also included in the contract was the trans-

fer of the high lift well pumps to the pump house to serve as two of the four booster pumps, the installation in the wells of two 350 gpm, 65 ft head, vertical turbine pumps, and the installation of one 600 gpm, vertical hollow shaft pump, and one 890 gpm, vertical hollow shaft pump in the booster station. This provided a total of 1780 gpm capacity at 355 ft total dynamic head in the station. The balance of this construction cost $54,-150.08 bringing the total construction cost of the project to $102,958.08.

Water Softening

This construction was complete in July 1958, and almost simultaneously the District was pressured by property owners in the balance of the area for the installation of water mains and water softening as an attraction to industrial and residential development. After careful consideration the Board of Directors decided that a bond issue sufficient to completely install water mains and laurels throughout the balance of the District, as well as a softening plant, would not be passed. Consequently, after a series of public meetings on March 4, 1958 a bond election was held to vote on $37,500 in bonds for a partial program. The issue was defeated 125 to 101, with the Board being informed that the tax paying electors would not pass any bond issue which did not include money for a softening plant. This was a surprise to the Board as the water being served to the customers was not extremely hard as can be seen from the analyses in Table 1.

The Board of Directors reestimated costs and called for an election on June 3, 1958 for a Bond issue of $500,000 to install 69,200 ft of pipe and construct a 1 mgd ion exchange type softening plant. The pipe cost was estimated to be $350,000 and the softening plant $115,000 with engineering and contingencies set at $35,000 for a total of $500,000. This election was successful with a vote of 137 to 105. Consequently, following bids, contracts were awarded for the construction of the pipe system for $326,099.95, and the softening plant for $107,494.91.

The engineers had earlier in the year designed an ion exchange type softening plant for the community of Littleton, Colorado with a capacity of 4 mgd on 16 grain per gal hardness water from the Platte River which has similar characteristics to the raw water of the North Washington Street Water & Sanitation District. It was felt by the engineers that to offer a revision of this same plant would possibly gain for the District a considerable increase in capacity at little additional cost. With this in mind the plant was redesigned. The net of the redesign and other simplification was a plant of 4 mgd capacity, when softening 30 grain water to approximately 15 grain water or 3 mgd capacity softening the water to 10 grain per gal. The plant consists of four 108 in. diameter by 78 in. high welded steel, tanks, with 6 in. headers. A high capacity sterene resin, having a capacity of 25,000 grains per cubic foot was used. Each filter contains 235 cubic foot in a bed depth of 44.4 inches deep. The calculated regenerative dosage is 0.4 pounds of salt per kilogram of regenerated bed or 2350 lbs of salt regeneration. The filter manufacturer also furnished one brine tank, (steel) 84 in. in diameter, 48 in. side water depth, along with all valves, controls, pressure piping necessary for the operation of the unit.

The water lines were installed in such a way that they could be chlorinated and used almost immediately following construction installation by the contractor. The softening plant was started in November 1958 and produces a water with its hardness reduced to 7 grains per gal.

On February 1, 1959, the District was serving water to 500 water customers with a future potential of approximately 2500 customers, as indicated from the present rate of subdivision activity in the area.

A VIEW OF THE ion exchange units at the Districts mgd softening plant.

The repayment to P-C Enterprises by the District consists of the District charging a tap fee of $250.00 for water, of which $200.00 is placed in an escrow account of the District. When this account reaches the cost of the plant, the option to purchase which has been exercised, takes place in fact. If this amount of money does not total the cost of the plant within the three year period following construction, then the District would be obliged to set aside revenue from operation in order to accelerate the accumulation of funds needed for the purchase of the plant. The total cost to the District when comparing the agreement terms will be approximately the same as if the District had financed the project with 5 per cent bonds over a 20-year period. Legally no debt exists on the District as there is no obligation to purchase and thus removing the possibility of being required to increase taxes.

Table I
WATER ANALYSES
NORTH WASHINGTON STREET
WATER AND SANITATION DISTRICT

	mg/l	mg/l as Calcium Carbonate	As Calcium Grains per gallon
Alkalinity (Methol-Orange)	302	302	17.7
Alkalinity (Pheonothaline)	0		
Calcium	158	396	23.2
Magnesium	22	86	5.0
Sodium	213	465	27.2
Sulphates	620	644	37.7
Chlorides	37	52	3.0
Silica			
Iron	0		
pH	7.4		
total hardness		482	28.2
total dissolved solids		998	55.4

NEW YORK SECTION, AWWA

A record 540 members and guests at the Annual Fall meeting were given a step-by-step outline for a . . .

Public Relations Program

A Staff Report

■ The technical program led off with subjects on speaking publicly and preparation of a motion picture designed to implement a public relations program.

HOW TO OBTAIN SPEAKING ENGAGEMENTS by W. T. Miller, Research Engineer, Cast Iron Pipe Research Association, Chicago, Illinois. Mr. Miller pointed out that water department officials in communities of 1500 to 20,000 population would probably have to exert initiative to publicize their activities. It is important that management executives joins local organizations, work actively on committees and make all possible contributions to public community life. Employees should be encouraged to be active also.

Do not wait for an invitation to speak. Political groups, service clubs, educational organizations and numerous other local activities need participants for their program schedules. Prepare notes on interesting subjects pertinent to your department and approach leaders of local organizations. After the initial contact, follow up with a reminder letter to indicate your enthusiasm about taking part in their program. Mr. Miller encouraged the preparation of exhibits for local home shows and participation to the greatest possible extent.

Above all, be accurate in your presentation. Use visual aids and deliver your speech first prior to using demonstrators or passing out literature. Arrange for newspaper publicity immediately following the meeting. Do this even though you have to write up the material personally. Submit it to the local newspaper, radio, and television stations. Do not be overly modest in your press releases.

HOW TO MAKE AND SHOW A MOVIE, by John E. Kleinhenz, Director of Public Relations, Indianapolis Water Company, Indianapolis, Indiana. Motion pictures can be used to good advantage by utility managers desiring to publicize the need for a new plant, rate increase, bond issue or other necessary activity on the part of the organization. The following steps are essential to preparation of any motion picture. The story should be written tied to the reason for the picture, appropriate shots should then be selected. A script should be arranged then the film should be shot and edited. It is desirable to have a print made from the original as well as having a black and white work print made if the original is in color. This preserves the original and protects it from damage.

The best motion picture contains scenes which are neither too short, nor too long, and that are descriptive of the subject. The speech should be taped using a musical background. This eliminates the necessity of repeating the same speech at every showing throughout the life of the motion picture. Mr. Kleinhenz encouraged his listeners to refer to technical manuals on the subject, taking advantage of all previous knowledge.

It is important that every advantage be given to displaying the motion picture properly. The room should be arranged previous to the showing, darkened, the stage should be set and insofar as possible the audience comfort should be considered. Do not hesitate to advertise the availability of the film showing it in advance of any public display to your superiors, the press, including radio and television and use posters to advertise its availability for showing. In order that the investment in the film may be properly pro-rated, keep accurate records of the showings and the number of people who observe the completed motion picture. Mr. Kleinhenz showed his color sound film "Plan to Plenty", the story of Indianapolis, Indiana's water system and "Priceless Water", the story of Rahway, New Jersey's water system.

As a wind-up to the Waterworks School, a black and white film from National Headquarters of the AWWA, entitled "What's In It For Us" was shown. This is a report of the San Francisco Meeting in July, 1959 and included a section entitled "A Salute to Harry Jordan" on the occasion of Mr. Jordan's retirement as Executive Secretary of AWWA.

PROBABLE ACCURACY FOR PROPORTIONAL PACING SYSTEMS by Frank Russo, Utilities Sales Division, B-I-F Industries, Inc., Providence, Rhode Island. This paper discussed the problems involved in determining the total accuracy of complex automated systems. He explained the determination of the resultant accuracy of multiple components designed into a system is possible by means of the root mean square formula which considers the known accuracy of each individual component in the system. Slides were used to illustrate both simple and complex systems and how the formula is used to determine the probable maximum error (PME) of each system.

PURE WATER AND PUBLIC HEALTH, a 31-minute motion picture produced by the Cast Iron Pipe Research Association was introduced by Mr. W. T. Miller, Research Engineer. This film is available for showing by Utilities Departments throughout the country.

MUNICIPALITIES, CONTRACTORS AND ENGINEERS —A LAWYER'S VIEWPOINT by Edgar A. B. Spencer, Partner, Spen-

cer and Tunstead, Attorneys, New York, New York. This interesting discussion presented the legal relationship between municipalities, contractors and engineers.

It was pointed out that municipalities are public corporations run by ordinary men. They are continually under close public scrutiny and subject to continuing political review. Organizations must operate within the law and within the authority granted to them by the law. In legal negotiations, municipalities should be careful to use qualified personnel for witnesses and reporting events substantiating their legal cases. Municipalities were encouraged to use fair, clear contracts which contain no trickery. This contributes to fair, competitive bidding on contracts and in the long run reduced the cost to the City of contractual work.

Contractors basically are in business to make a profit. They must clearly understand the terminology of the contract documents. Successful contractors more often than not work with their attorneys to obtain a clear understanding of exactly what each job they bid entails. Jobs indicating a high degree of risk will include proportionately high dollar values to cover these risks. On the other hand, the jobs which have a clearly written contract with no trickery will have proportionately lower figures included from the contractors normally in proportion to the degree of risk involved. Contractors will watch carefully to visualize who is going to interpret the contract documents. If a legal organization has been active in the project, bid preparations will be affected accordingly. Good contractors consult their attorneys before bidding to be certain exactly what the contract documents contain. In this manner they are protected against trickery and are in a position to defend themselves should the occasion arise.

Consulting engineers should draw clear specifications, and the contract documents should ask the contractor to take no risks which good engineering can avoid. A payment schedule should be established which will tend to prevent bid un-balancing. Engineers should more freely admit errors and omissions and not hold contractors and municipalities liable for these items in the contract documents and specifications. Considerable difficulty could be avoided if engineers would depend on attorneys to prepare the contract form in documents for public and private bidding.

RADIOLOGICAL FALLOUT AND CIVILIAN DEFENSE moderated by Vice-Chairman C. M. Taylor, Oneonta, New York. The panel discussion brought out the importance of understanding the source of fallout such as weapons tests and nuclear energy plant accidents. The possibility of contamination from nuclear warfare is the final source which could heavily contaminate specific areas and interfere greatly with the general population. Some discussion of the nature of radio isotopes and the tissue damages they can cause was given. These remarks were made by Mr. J. E. O'Brien of the New York State Civil Defense Commission.

MATCHING FUNDS FOR PUBLIC UTILITIES by Raymond Barbuti, Deputy Director for Administration, New York State Civil Defense Commission. Operators and superintendents were encouraged to apply for matching funds for auxiliary power units, pipe fittings and two-way radio equipment. Waterworks have not participated to any great extent in the matching funds program.

A "Round-Table Conference" with Mr. Donald E. Stearns, P. E., Casanovia, New York as leader was well attended. Major topics for discussion had been selected in advance of the program. *Your Practice in Thawing Water Service*, this subject brought considerable discussion from the Association members. In most cases the service line thawing is charged to the customer, often because regulations give the water department no authority beyond the curb stop. At least one community provides thawing service at no charge to the customer. This is considered good will service which pays off in the long run, helping when rate increases and bond issues are needed. One Utility hires an independent contractor to thaw service lines and this contractor makes a direct charge to the customer. When electric equipment is used to thaw service lines, the service should be disconnected at the meter pit to avoid grounding connection which could carry into the building and destroy electrical wiring.

YOUR TROUBLES FROM SPRINKLING LOADS. This problem has plagued certain members of the New York Association for many years. The Long Island group in particular has continuing problems which cannot be solved economically through installation of over-sized mains for the period when loads occur. The concensus of opinion was that a sprinkling ordinance should be passed allowing the superintendent to establish sprinkling hours. Regulations must be policed and infractions could be met by turning off sprinkling services, not household water service. This applies particularly to separately installed sprinkling connections ordinarily separate from the domestic household water supply.

TELEMETERING AND AUTOMATION. The maintenance of complex automatic equipment for telemetering was discussed. It was pointed out that initial engineering should assure that the equipment was properly applied. Suppliers of equipment have maintenance service contracts which are available at low cost and save money in the long run. In addition, these contracts provide competent service to the equipment on a regular schedule. Organizations having extensive installations of automatic equipment should train one or two men to be competent for emergency service of all components of the system. This is possible by sending maintenance personnel to supplier's training schools.

SIZING DISTRIBUTION SYSTEM MAINS. Insurance ratings may be a major basis for standardization of minimum size mains in distribution systems. Many communities have no mains smaller than 8 in. as their current standard. Utility managers should pay close attention and ask for cooperation from insurance rating organizations in establishing a minimum size and appropriately sized distribution mains. With regard to suburban developments utilities should work closely with realtors in sizing sub-division feeder lines. In some cases realtors are required to stand the cost of all distribution mains in the development. However the utilities system should insist that standards be maintained in installations of all sub-division mains. It was brought out that dead-end mains should be at least 8 in.

Part 16 of this series on the Design, Construction and Maintenance of Centrifugal Pumps introduces the subject of . . .

Vertical Pumps—*Part I*

by IGOR J. KARASSIK, Consulting Eng. and Manager of Planning, Harrison Div., Worthington Corp., Harrison, N. J.

EDITOR'S NOTE: This first of three parts on vertical pumps gives the reasons for selection of this type of arrangement and discusses the installation of such equipment in dry-pit applications. The two other parts included under the same heading will deal with wet-well (submerged) applications and with servicing and maintenance of both types.

■ A LARGE AND IMPORTANT portion of the field of application of centrifugal pumps utilizes units arranged with vertical shafting. And although the basic elements of a centrifugal pump are essentially similar regardless of the position of the shaft, it is obvious that they must vary in their execution, depending on whether the shaft is vertical or horizontal. The preceding group of articles dealt primarily with horizontal pumps and their individual structural elements. This and the following two articles will discuss details of construction which apply specifically to vertical arrangements.

Preference for a vertical arrangement may be based on several factors. In a few cases the vertical design is preferred because of the advantages of reduced floor space, as in the case of marine pumps. In other cases it is desirable to mount the pump at a low

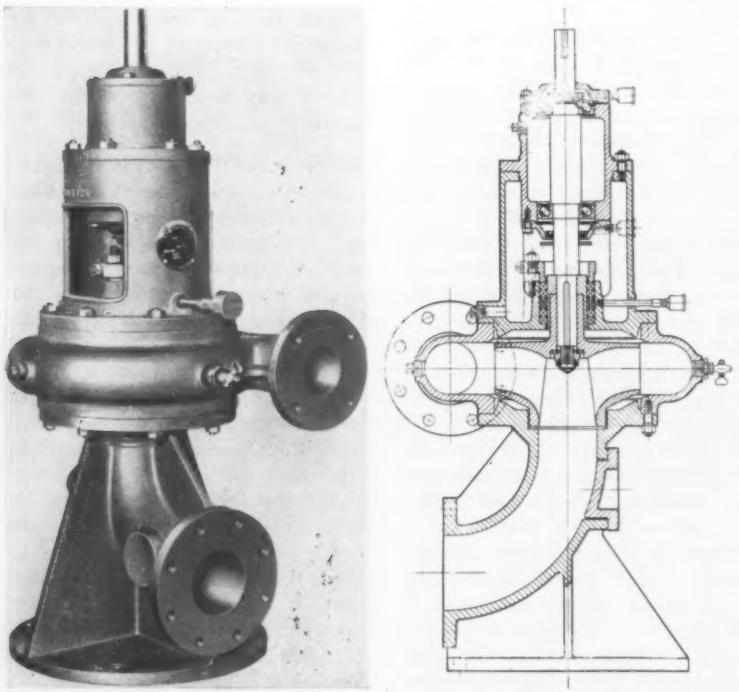


FIG. 1. TYPICAL small-capacity vertical sewage pump for drive through intermediate shafting.

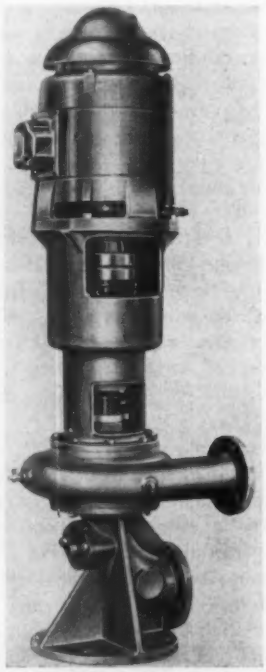


FIG. 2. VERTICAL sewage pump similar to Fig. 1, but with direct-mounted motor

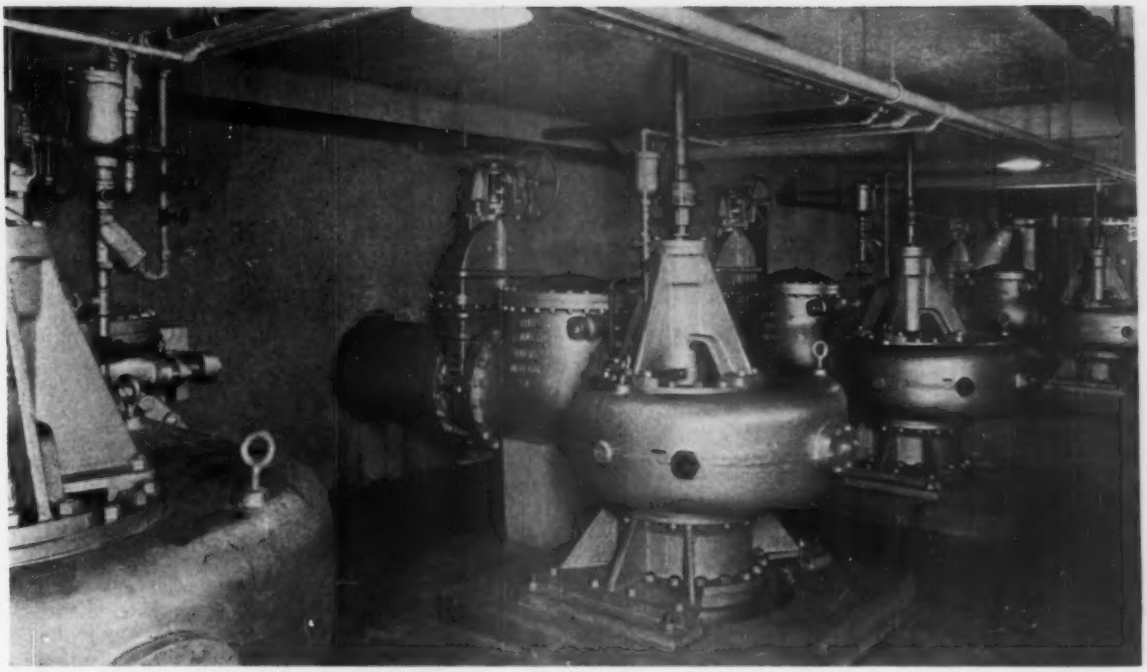


FIG. 3. INSTALLATION of vertical bottom-suction volute pumps with piloted couplings.

elevation because of suction conditions, but also preferable or necessary to have the driver at a high elevation. The vertical type is generally used for very large capacity pumps because, when all factors are considered, it is more economical than the horizontal type.

Vertical shaft pumps can be classified into two separate groupings: the dry-pit type and the wet-pit type. The former operate surrounded by air, whereas the latter are either fully or partially submerged in the liquid that they handle.

Vertical Dry-Pit Pumps

The field of application of vertical dry-pit pumps with external bearings is quite varied. It includes most of the vertical sewage pumps from small to the largest, and most of the medium and large drainage and irrigation pumps, for medium and high head. It includes also many large water supply pumps and many large condenser circulating pumps. Finally, most vertical marine pumps are also of the dry-pit type.

Some vertical dry-pit pumps are basically horizontal designs with minor modifications, generally in the bearings, to adapt them for vertical shaft drive, such as shown in Fig. 5. The reverse is true for small- and medium-size sewage pumps, as the vertical type is the most popular for that service. Most of these small- and medium-size sewage pumps have elbow suction nozzles (Figs. 1 and 2)

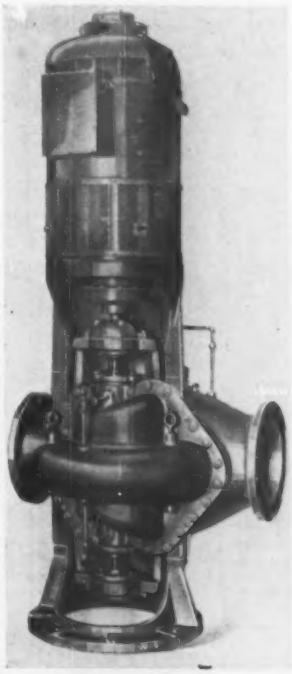


FIG. 4. VERTICAL double-suction volute pump with direct-mounted motor.

as the suction supply is usually taken from a wet well adjacent to the pit in which the pump is installed. Generally, the suction elbow contains a handhole with a removable cover in order to provide easy access to the impeller.

When dismantling such a pump, the stuffing box head is unbolted from the casing after the intermediate shaft or the motor and motor stand have been removed. The rotor assembly is drawn out upwards, complete with the stuffing box head, the bearing housing, etc. This rotor assembly can then be dismantled completely at a convenient location.

The larger sewage pumps, as well as the larger drainage, irrigation, condenser circulating and water supply pumps, are generally of the vertical bottom-suction type (Fig. 3). Except for sewage service, these other services occasionally can employ a vertical double-suction type of pump, as in Fig. 4. When a vertical pump is applied to condensate service or some other service for which the eye of the impeller must be vented to prevent vapor binding, a pump with bottom single-inlet impeller is not desirable, as it does not permit effective venting. This likewise is unattainable for the lower eye in a vertical pump employing a double-suction impeller. For

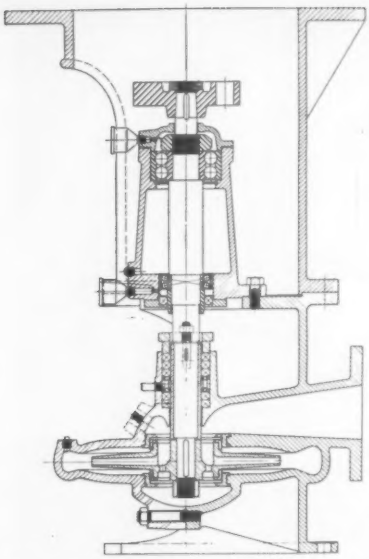


FIG. 5. SECTION of vertical pump with top-suction impeller.

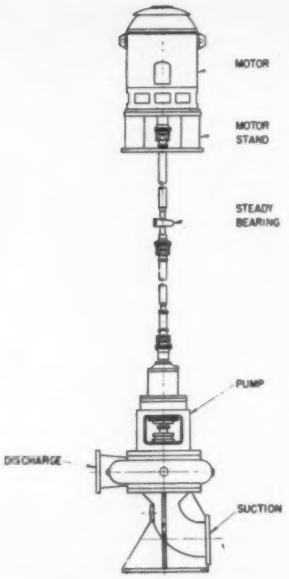


FIG. 6. TYPICAL elevation of vertical pumps with tubular shafting.

FIG. 7. TYPICAL elevation of vertical pump and solid shafting with motor supporting rotating parts.

such vertical pumps the most suitable design would be one with a top single-inlet impeller, as shown in Fig. 5.

Driver Location and Connection

When the driver of a vertical dry pit pump can be located immediately above the pump, it is often supported on the pump itself, as in Figs. 2 and 4. The shafts of the pump and the driver may be connected by a flexible coupling, in which case each must have its own thrust bearing. In other cases the pump shaft is rigidly coupled to the driver shaft or is an extension of the driver shaft and a common thrust bearing is used, generally in the driver.

When the driver of a vertical pump is to be mounted some distance above the pump, intermediate shafting must be used to connect the two. The design of this shafting depends on the power to be transmitted, the speed, the total length, and the bearing design used in the pump and in the motor.

The shafting connecting a small- or medium-size centrifugal pump with its driver is now usually of the universal-joint type with hollow tubing (Fig. 6). The lower section has a universal joint at both ends, whereas each upper section (if more than one section is used) has a guide bearing supporting the lower end and a universal joint at the upper end. This type of shafting compensates for angular misalignment and, as the lower section

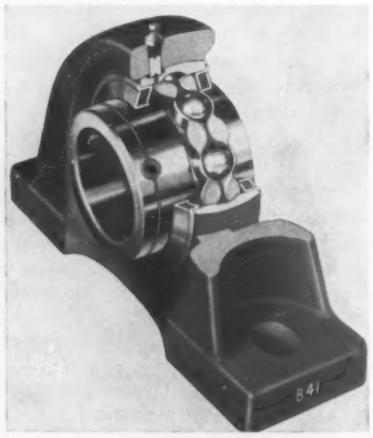


FIG. 8. TYPE of ball bearing used as intermediate shaft steady bearing in smaller units.

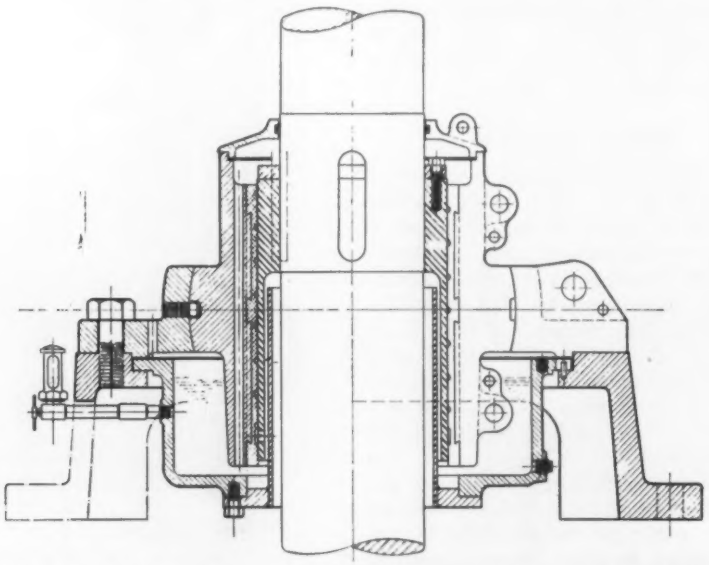


FIG. 9. SELF-OILING type of steady bearing used for large vertical shafting.

also incorporates a splined joint, also compensates for any minor discrepancy in length. When speed permits, shaft sections up to 120 inches or more in length can be obtained. Sections longer than 10 feet are easily sprung and must be handled carefully.

This shafting does not transmit thrust, so the pump and driver must each have a thrust bearing. Usually the driver is supported above the supporting floor on a stand, permitting access to the flange connection and upper universal joint for bolting up the flanges and relubrication. The driver must be of the solid-shaft type or, if of the hollow-shaft type, must be provided with a head shaft guided by a lower bearing to act in the same capacity.

Except for the lowest universal joint, the weight of this shafting is carried on the motor. Except for extremely long shafting installations, the total weight involved is relatively small and a normal thrust motor can be used. Actually this is a more expensive type of shafting than solid shafting. However, because the basic universal joint has a larger field of application on automobiles and trucks, it is a production item and the increase in cost over solid shafting is very reasonable.

For intermediate shafting of units requiring more torque than can be carried by the available sizes of universal-joint type of shafting, solid shafting is used, either with solid couplings or with flexible-type couplings. If solid or rigid couplings are used, only one thrust bearing, usually in the driver, is needed; all other bearings are merely guide bearings. This type of shafting has the disadvantage that all the bearings of the unit must be in very accurate alignment, which is difficult of attainment with open shafting if more than three bearings are involved.

Solid vertical shafting using flexible couplings usually consists of shaft sections (including pump and driver) each with two or possibly three bearings connected by floating shaft sections with a piloted or guided flexible coupling at each end, thus acting in effect like a universal joint (Fig. 3). Naturally, each section with bearings must have one bearing acting as a thrust bearing to carry the weight of the shaft section.

The intermediate shafting for large pumps which require large shafts is usually of the solid type with solid couplings of the flanged type. In many cases these are forged onto the shaft sections (Fig. 7).

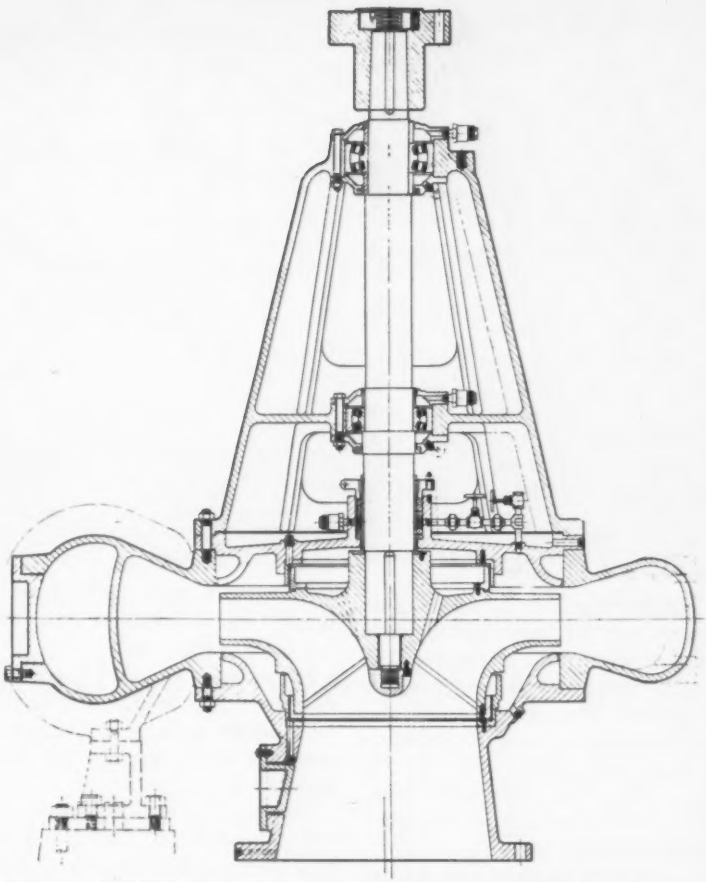


FIG. 10. SECTION of vertical bottom-suction pump with twin volute.

The size of the shafting to be used for an installation may be determined by the torque to be transmitted. However, if a certain span between bear-

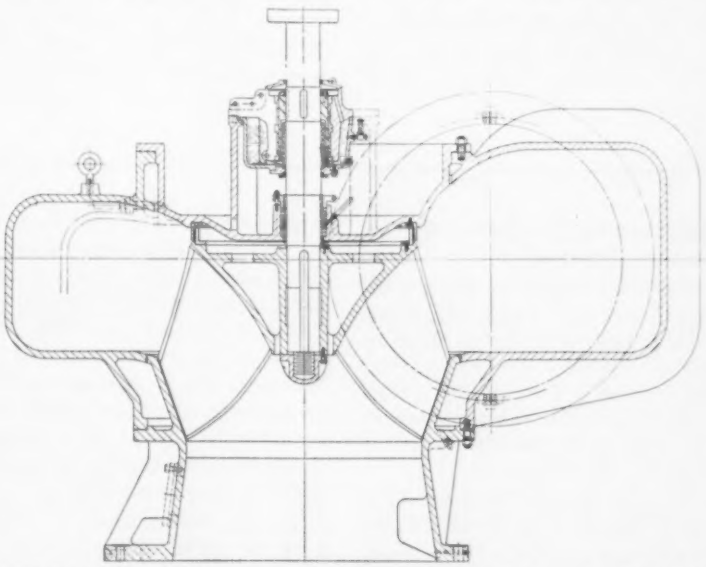


FIG. 11. SECTION of large vertical bottom-suction volute pump with single guide bearing at pump.

ings is desirable because of existing supports (floors or beams), a shaft larger than required by the torque may be necessary so that the operating speed will be sufficiently below the critical speed. In this connection, it is general practice to have the first critical speed above any operating or runaway speed of the pump. The critical speed of a vertical solid shaft is a direct function of the diameter and an inverse function of the square of the span between bearings. Thus, for a shaft running at twice the speed of another, the first shaft has to be twice as large in diameter for the same bearing span or its permissible bearing span will be reduced to 70 per cent of that permissible with the lower speed.

Bearings and Supports

The bearings for vertical dry-pit pumps and for intermediate guide bearings are usually of the anti-friction type, grease-lubricated to simplify the problem of retaining the lubricant in a housing having a shaft projecting vertically through it (Fig. 8). In larger units where anti-friction bearings are not available or desirable, self-oiling babbitt bearings or forced-feed-oil babbitt bearings with a separate oiling system are used (Fig. 9).

It is important that the supports for the guide bearings of vertical shafting connecting a centrifugal pump and its driver be sufficiently rigid. The radial load is usually assumed to be the same as if the unit were in a horizontal position. With this loading, the deflection of the supports in any direction should not exceed

$$\Delta = (187.7/n_c)^2$$

where Δ is the deflection, in inches, and n_c is the critical speed of the shafting. This critical speed is usually 125 per cent of the pump rotative speed or some value above the possible runaway speed, in case there may be backflow through the pump.

If beams or channels are used to support the bearings, the design of the latter is naturally dependent on the span between the bearings, the radial force, and the permissible deflection. Small pump installations with short spans generally require a single channel, to which vertical surface-mounted bearings are most easily attached. Larger units with long spans often require fairly widely spaced channels or beams with strengthening lattice work. With this type of bearing support, a horizontally-mounted guide bearing resting directly on the beams or on a bridging plate is more convenient. These considerations lead to a tendency to use vertically-mounted guide bearings for smaller units and horizontally-mounted guide bearings for larger units.

Structurally, vertical dry-pit centrifugal pumps are similar to pumps with horizontal shafts. It is to be noted however, that many of the very large vertical single-stage single-suction (usually bottom) volute pumps (which is the preferred type for large storm water pumpage, drainage, irrigation, sewage and water supply-projects) have no comparable counterpart in the horizontal-shaft type. The casings of such pumps are basically of the U section, which is structurally weak, often necessitating heavy ribbing in order to make the casing sufficiently rigid. In comparable water turbine practice, a set of vanes (called a speed-ring) is employed between the casing and the runner to act as struts. Although such a speed-ring does not affect the operation of a water turbine adversely, it would function basically as a diffuser in a pump, with the inherent hydraulic limitations of that construction. Some of the high-head large pumps of this type have been made in the twin-volute design. The wall separating the one volute and the passageway of the other from the tip of the volute to the discharge nozzle acts as a strengthening rib for the casing, thus making it easier to design a casing strong enough for the pressure involved (Fig. 10).

Vertical pumps with bottom single-inlet impellers (Figs. 1 and 10) have a leakage joint between the wearing ring hub of the impeller and the suction head. When pumps of this type are handling gritty liquids the grit separates out during periods of shutdown and concentrates at or near this joint. When the pump is again started, this concentration of grit is washed through the leakage joint, with resulting wear. With large pumps, a ring construction (as shown in Fig. 11) is feasible; this involves extending the stationary ring above the suction head, forming a pocket in which the grit will be deposited and from which it can be flushed periodically. These and other refinements are feasible in large pumps, but not in small ones.

Engineering Projects on Postage Stamps

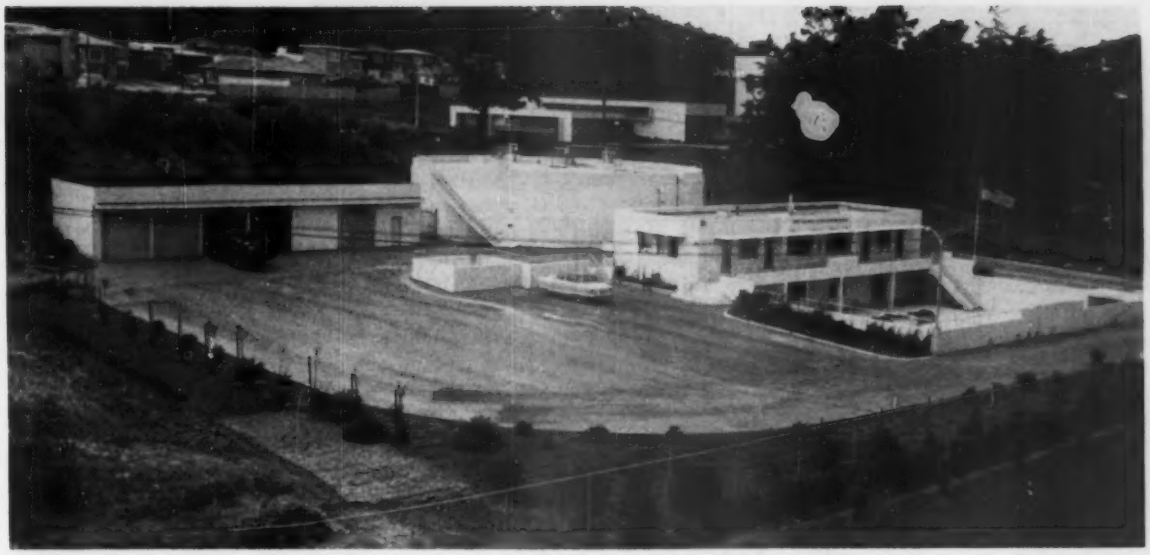
The Engineers Joint Council has pointed out that, lately, engineering achievements are being displayed on postage stamps. One of the recent issues depicts a water purifying plant in the Netherlands West Indies; the issue was by the Island Territory of Aruba.

The new plant so honored is the world's largest single installation for converting sea water to fresh water (2,700,000 gpd), and the first conversion plant to produce marketable surplus electricity (12,500 kw).

The first engineering project depicted on a United States postage stamp was the Mississippi Rive Bridge at St. Louis, in 1898. More recently, stamps have shown the Mackinac Straits Bridge (1958); the Grand Coulee Dam (1952); and the Atlantic Cable (1958 centenary). Two bridges, the George Washington and a stylized covered bridge, were shown on a stamp issued in 1952 to mark the 100th anniversary of the American Society of Civil Engineers.

From time to time, such industrial project as oil refineries, chemical plants, paper mills and shipyards have appeared on stamps. The Japanese have shown a famous, two-level tunnel, and the Russians have depicted their dams and power plants. Even superhighways are beginning to make occasional appearances.

Engineering societies, concerned with improving the status of engineering and the recognition of engineers, could develop programs to encourage more United States stamps of this kind. The EJC suggests that the new United Engineering Center would be a worthy first candidate.



A residential area remains attractive because sewage treatment stays indoors assisted by . . .

Centrifugal Filtration *of digested sludge*

by WILLIAM F. WHITE, Sales Engr.
Bird Machine Co.

EDITOR'S NOTE: To take advantage of gravity flow in the sewerage system, design engineers and city officials selected a site in a residential district to construct a sewage treatment plant. Units were placed underground, camouflaged into the landscape, or isolated indoors.

■ SLUDGE HANDLING activities at a primary treatment plant sited in the midst of an attractive residential area are hidden from the eyes of the community. In fact, a casual passerby would hardly recognize the building and a digester next to the hillside as a sewage treatment plant. Other units, the covered rectangular sedimentation tanks and clarifiers, are installed underground. The plant was designed and constructed to take advantage of gravity flow while eliminating any nuisance from odors or unsightly appearance because of its location.

This North San Mateo County Sanitation District Sewage Treatment Plant is located in Daly City, Calif., adjacent to Westlake Recreation Park. The sanitation district, South of the City of San Francisco, is comprised of an area approximately four square miles, and serves a population of 45,000. There are approximately 80 miles of sanitary sewers in the district, of which six areas are handled by gravity drainage and three are served by lift stations which discharge into the gravity drainage system.

A flow sheet of the plant is shown in Figure 1 and design data is given in Table 1. The treatment consists essentially of comminution, primary sedimentation, primary sludge digestion, centrifugation and pre and post chlorination.

Planning

The consulting engineers, relying upon their experience in the sanitary field used considerable ingenuity to produce a plant design that conformed to the aforementioned requirements.

Sludge drying beds for dewatering digested sludge were unthinkable from an esthetic viewpoint and capital costs too. The conventional alternate of rotary vacuum filters was considered too expensive. Operating costs for chemical pre-treatment of the sludge prior to vacuum filtration was another factor. This would have meant continual chemical cost and constant attention on the part of operators and the laboratory.

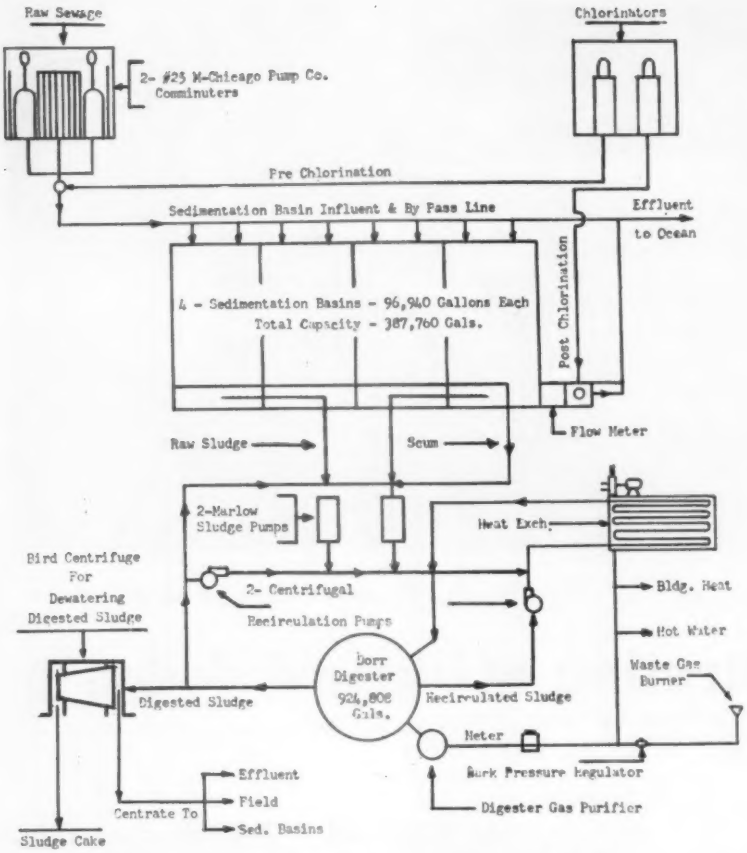


FIG. 1. FLOW SHEET of Daly City Sewage Treatment Plant.

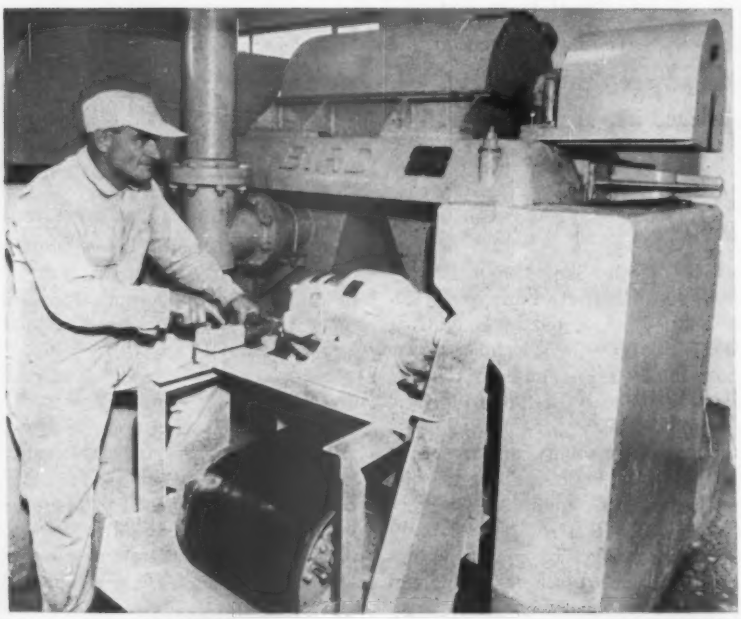


FIG. 2. BIRD CENTRIFUGAL FILTER being started by Lawrence Giuffra, Chief Operator.

After careful study, the consulting engineers selected a 18 by 28 inch Bird Continuous Centrifugal Filter for dewatering digested sludge. This type filter takes up a minimum amount of space and requires no chemical pre-treatment, thus eliminating the necessity for chemical storage and handling facilities, feeders, mixers, flocculating tanks.

Centrifugal Filter

The unit has more than ample capacity to handle the entire volume of digested sludge. The centrifuge is currently operated approximately ten hours per week over a three day period. Sludge is pumped directly from the digester to the centrifuge at a rate of 15 gpm. Sludge concentration is generally 7.0-8.0 percent solids. The filtrate or centrifuge effluent contains 1.5-2.5 percent solids by weight.

Table 1
Basic Engineering Design

Plant Capacity	
Average design flow (Based on 100 gpcd)	4.0 mgd
Hydraulic Capacity (Peak Flows)	12.0 mgd
Primary Clarifiers (at aver. flow)	
Settling period	2.5 hr
Overflow Rate	700 gpd/ft²
Sludge Digestion Tank	
Volume	+3.0 cu ft/cap
Sludge gas heating	95°F
Degree of Treatment	
Reduction Settleable Solids	98.5%
Reduction Suspended Solids	65%
Reduction of B.O.D.	30%
Chlorine demand of plant effluent	8.0 mg/l

The described centrifuge operates at 1900 rpm and develops a centrifugal force equivalent to 935 times gravity. In an effort to improve the clarity of the centrate, and the efficiency of removal, the manufacturer has made design modifications to the equipment so that this size centrifuge could be operated at 3500 rpm or equivalent to 3000 times gravity. Indications are that removal efficiency can be increased by the increased centrifugal force. At present, dewatered sludge from the centrifuge averages 30-35 percent solids by weight. It is collected on a belt conveyor which delivers it to a truck for disposal. The sludge is in a shredded form and easily handled.

The city obtains approximately 9 cu yd per week of filtered sludge for

use as a soil condition. The sludge receives no further treatment. It is used on the grounds of the treatment plant which abound in beautiful flowers and emerald lawns. The Park Department of Daly City uses it on its several recreation parks. At present it is available to city residents, at no cost, for use on their flowers and lawns.

Plant Experience

During the two and a half years of centrifuge operation, the centrifuge effluent has always been returned to the primary sedimentation basins. However, no adverse effects on digestion or centrifuging have been experienced. The design capacity of the digester is generous (in excess of 3 cu ft per cap). Currently the effluent from the plant is given post-chlorination, prior to discharge to a 24 inch outfall extending into the ocean. As yet, it has not been possible to determine any increased chlorine demand existing when centrifuge effluent is being returned to the primary.

There are provisions to discharge the centrifuge effluent directly to the plant effluent rather than return it to the primary. If the solids load could be reduced within state requirements possibly this step could be eliminated.

One problem was experienced after the centrifuge was in operation for approximately a year. This involved sludge accumulations inside the centrifuge.

Equipment modifications were made, which successfully eliminated this difficulty. The centrifuge has since proven extremely reliable, requiring a minimum of operator attention, and only a nominal amount of maintenance.

11 Communities May Form Sewer District

The possibility of creating a sewage district for 11 communities in Wisconsin's Waukesha County will be studied under a program approved by engineers and public officials.

The cooperative approach to the problems of collecting and treating sanitary wastes and drainage was outlined by O. J. Muegge, state sanitary engineer and a member of the Wisconsin Committee on Water Pollution. He said improperly operating septic tanks in many areas of Waukesha County posed a health hazard.

"Following trends," he added, "the area will reach one and a half million people, so plan now to avoid difficulties of being swamped by waste disposal problems."

Raymond D. Leary, general manager of the Milwaukee Metropolitan Sewage Commission, was among engineers who agreed that the idea of a metropolitan sewage district was practical for Waukesha County.

Arid Lands Study

A three-year research program, supported by the University of Arizona, The Rockefeller Foundation, and the groundwater branch of the U.S. Geological Survey, has, according to a recent report, produced a significant development that may change the whole concept of groundwater recharge in Arizona and other regions.

In the initial report, Dr. A. R. Kassander, Jr., chairman of the arid lands research committee and director of the University's Institute of Atmospheric Physics, pointed out that "new concepts developed in the preliminary phases appear to alter significantly some of the published and commonly accepted explanations of relationships between geology and the occurrence of groundwater in this basin . . . Reconnaissance studies in other Arizona basins confirm that similar relationships hold elsewhere . . ."

In explaining the new concept, the report said it "holds that in many basins the fine-grained deposits lap against the mountain fronts with no intervening zones of coarse materials, except locally-opposite mouths of tributaries. Re-evaluation of the hydrology of certain basins in the light of this concept will follow more detailed studies of the actual geologic relationships."

Japanese Water Specialists Tour South California

Ten Japanese water specialists are touring prominent Southern California water projects this week as part of an I. C. A. tour investigating ways of solving water pollution problems in Japan. The group, headed by Koichi Aki, Ph.D., Professor at Tokyo University, and U.N. Advisor to Dag Hammarskjold, visited the Los Angeles offices of Daniel, Mann, Johnson, & Mendenhall, Architects and Engineers, to inspect the firm's work in local water projects as well as their water supply programs for the governments of Thailand and Venezuela.

As guests of the state of California, Department of Water Resources, they inspected the plans for the Feather River Project which offers features of water conservation applicable to Japan where the supply of fresh water is so short that it is causing industrial production bottlenecks.

Household Aerobic Sewage Treatment

The scope of current studies on the effects of effluent from individual household aerobic sewage treatment devices on soil absorption systems, conducted by the Sanitary Engineering Research Laboratory of the University of California, has been widened.

Within the past five years the development, promotion and increasing sales of aerobic sewage treatment systems for individual households have stimulated interest in the behavior of liquid effluents from such systems when discharged to subsurface drainage fields or percolation wells of the type commonly used with septic tank installations. In the absence of experience with sub-surface disposal of aerated liquids, fear has been expressed that this type of effluent will rapidly air-bind the soil, thus causing the system to fail. Other proponents suggest that anaerobic decomposition insures the production of an effluent so superior to that from an aerobic cycle of the septic tank that the requirements for ultimate disposal of the effluent may be considerably relaxed.

If either of the foregoing possibilities should prove feasible from technical and public health viewpoints, the individual home aerobic sewage treatment unit could become an attractive possibility wherever soil condition are unsuited to conventional septic tank effluents. However, the evaluation of the merits of the aerobic system must be based on a comparison with the septic tank system and can be so compared only when the soil-effluent relationships for the septic tank effluent have been better established.

Dallas Meeting opened with discussions and papers on the Nations' number issue

WATER RESOURCES

EDITOR'S NOTE: Mark D. Hollis, new FSIWA President, started the meeting off by stating that "Water, its use and misuse, has become a number one national issue." The following eleven technical sessions further explored in detail the many facets of this basic problem area. The report abstracts many of these papers.

Other events included concurrent inspection trips to the Dallas and Trinity River Authority Sewage Treatment Works, and the Industrial Wastes Treatment Plant of the Texas Instruments Co. Also, for the first time, a WATER & SEWAGE WORKS MANUFACTURERS ASSN. held its first luncheon in conjunction with the FSIWA meeting . . . . wherein the manufacturers were given details concerning the WSWMA new Public Relations Program.

W. P. C. F.

As adopted by the Federation Board of Control a few weeks after the Annual Meeting in Dallas of the FEDERATION OF SEWAGE AND INDUSTRIAL WASTES ASSOCIATIONS, the new name of the society was changed to WATER POLLUTION CONTROL FEDERATION.

■ U. S. PUBLIC HEALTH SERVICE VIEW OF WATER RESOURCES by M. D. Hollis, • new FSIWA President. Water, its use and mis-use, has become a number one national issue, he said. The current population growth taxes essentially fixed water resources and a continuing avalanche of technological changes is outmoding traditional parameters. Future difficulty will come from microbiological and chemical substances having composite effects on water resources. He noted that our conventional water and waste treatment technology is not abreast of the trends. A vastly expanded research program is needed in order to find the right answers to new questions. We originally fought germ diseases and this will continue, he said, though the problem is now broadened to include new types of pollution. Long term and chronic effects are major questions which must be answered.

Stepped-up construction, increased and improved treatment and expansion of the water quality network are all now under way. In vestigation in the following areas is suggested by Dr. Hollis: establish engineering parameters to assess total pollution; probe for new methods of waste treatment geared to remove any and all contaminants; evaluate health and economic effects to crystallize public opinion and establish a basis for national policy. Above all, the industry needs an increased flow of trained engineers and scientists.

■ INDUSTRIAL VIEW OF WATER RESOURCES by N. D. Griswold, Dow Chemical Co., Freeport, Texas.

Industry is often faced with a confusing complex of laws relative to water use and re-use. This applies when relocation is necessary at sites where sufficient water is available and where industrial use and release following use is acceptable. Figures on water availability need improvement based on criteria other than average figures.

Mr. Griswold emphasized that availability of sufficient water of good quality is only one requirement. However, having located in an area, continued vigilance must be maintained to preserve adjacent areas from contaminating wastewaters. The increased consumptive use of water, as in the use of multiple-pass condensing and cooling equipment, is an area where industry practice water resource conservation. Industry must continue to recognize its obligation as a good neighbor, treat its own wastes and encourage general understanding of the water resources problem.

■ STATE AGENCY VIEW OF WATER RESOURCES by Milton P. Adams, Executive Secretary, Michigan Water Resources Commission, Lansing, Michigan.

Since several states have been concerned with water resources longer than government agencies, they should be free to criticize the Federal view-point. One aspect of the problem lies in the differing attitudes between the states: those having water appropriation rights vs those concerned with riparian rights of reasonable use. The state agency, he said, generally has no say in industrial plant location, though orders may be issued concerning the amount of water used and wastes disposed. The sewage and waste treatment process must provide an adequate reserve of water. Present treatment methods will not fully realize the potential and satisfy the water resource requirement of the

future. For the present, industry can contribute to water resource conservation by making less water do more work and serve more people.

■ CONTROL OF RADIOACTIVE POLLUTION OF THE ANIMAS RIVER, by E. C. Tsivoglou (In charge, Radiological Water Pollution); M. Stein (Chief, Enforcement Branch, Division of Water Supply and Pollution Control); and W. W. Towne (Deputy Chief, Technical Services Branch); all of the U.S. Public Health Service (respectively Cincinnati, Washington, and Cincinnati).

The Animas River, flowing through southern Colorado, receives wastes from uranium mining and milling operations. Downstream, in New Mexico, the river is used by two communities for municipal water supply. In 1958, because of possible radioactive pollution in the river, the State of New Mexico requested the U.S. Public Health Service to study the Animas River as a case of pollution crossing an interstate boundary. The Service was asked to measure the pollution, to interpret its significance, and to suggest remedial actions.

Dr. Tsivoglou emphasized the cooperation that the Public Health Service had received from all parties during this survey. In uranium milling, only the uranium concentrate is desired and all other elements and chemicals are unwanted wastes. Most serious of these are radium and strontium-90; these elements enter the bone structure of animals, including man, after ingestion with food or water. The total quantity ingested over a period of years or a normal lifetime is more critical than the concentration in water at any particular time. USPHS recommendations are based on total ingestion, using standards from Handbook 52 with modification for the general public rather than for workers in radioactive materials.

It was agreed, in public hearings, that the company would continue its efforts to reduce contamination of the Animas River, striving particularly to eliminate all settleable radioactive solids, to reduce still further the concentration of dissolved radium, and to stop the discharge of toxic but nonradioactive process chemicals. A follow-up survey, to evaluate the success of these measures, will be made in late 1959.

Design and Operation

■ DESIGN, CONSTRUCTION, AND OPERATION OF SEWER OUTFALLS IN ESTUARINE AND TIDAL WATERS, by Frank L. Heaney, Sanitary Engineer, Fay Spofford and Thorndike, Boston, Mass.

Mr. Heaney related some of his experiences with sewage disposal into ocean waters from communities of 14,000 to 100,000 population, along the New England coast. Usually the only treatment provided is ¼-inch screens, plus chlorination during the summer months if bathing may be affected. Experience in this design is more important than theory, and existing works should be visited and studied. The service conditions, due to continuous pounding by the ocean, are severe.

Scale and grease deposits decrease sewer flow capacity, and are made worse by the cold ocean environment. Maintenance is difficult at best, and should be provided for in the original installation. Other problems of ocean disposal are floating objects such as grease balls, shellfish damage by deposition of solids, and slick areas on the water surface.

Expensive long installations into deep water, involving more costly maintenance, may be eliminated by providing additional treatment prior to discharge. Outfall location may be a major problem, involving consideration of underwater topography and tidal currents as well as costs. Holding tanks may be used to retain the sewage during periods of unusually high tide.

■ OPERATING EXPERIENCES AT CAMDEN, N. J., SEWAGE WORKS, by Vincent P. Brunick, Assistant Superintendent of Sewage, Camden, N. J.

Camden sewerage problems are complicated by a seasonal industrial waste load of 350,000 population equivalent two to three times the actual capita count. The industries include canning, soup manufacture, wool scouring, dyeing, and chemical manufacture.

Mr. Brunick described breaking-in difficulties of the Camden primary treatment plant. Hydraulic *underload* causes troubles, especially on weekends. Manual operation of pumps is resorted to in order to prevent frequent starts and stops. Pumps are backwashed regularly and the pump well is cleaned frequently to prevent solids build-up.

In canning season, excessive grit and sludge is a problem. Sludge may be held for periods up to six days (with partial digestion) before filtration. Lime and ferric chloride are used for chemical conditioning of sludge. Filtration characteristics vary seasonally, being particularly good during tomato season; other factors such as Btu value of sludge also vary with industrial activity. Hourly laboratory pH and filtration tests are used to control chemical additions.

■ DESIGN AND OPERATION OF THE LOUISVILLE, KENTUCKY, SEWAGE TREATMENT WORKS, by Frank A. Marston, Partner, and Robert W. Muther, Jr., Project Engineer, Metcalf and Eddy, Boston, Mass.

Primary treatment by sedimentation is designed to provide substantially complete removal of settleable solids, and 45% removal of total suspended solids. Space is available for the later addition of secondary treatment or for a higher degree of primary treatment, if these are ever needed. The plant is designed for a 1977 population of 510,000.

Treatment is not needed during river flood stages; discharge then is directly to the river by gravity or pumping. The longest period out of operation has been five weeks, during January-February 1959. There were no real problems; gas production slowed but resumed satisfactorily with gradual start-up.

The treatment plant includes a mechanically raked bar screen, aerated grit chambers, settling tanks, separate sludge digesters, elutriation tanks, and vacuum filters. The filter cake is trucked five miles for drying and burning at the city incinerator.

Management

■ MANAGEMENT OPERATIONS OF THE SEWAGE WORKS IN SAN FRANCISCO, by Ben Benas, Purchaser, City and

County of San Francisco; Walter B. Jones, Acting Superintendent, and Keeno Fraschina, Acting Senior Engineer, Bureau of Sewers and Sewage Treatment, San Francisco, California.

This paper was read by Don Reinsch. It reported that there are 248 regular employees in the Bureau of Sewer and Sewage Treatment, of which 106 are in sewage treatment, 13 are in sewage pumping, and 129 are in sewer maintenance and repair. The Bureau expenditures for 1957-58 totaled $1,930,000. Of this amount, $998,000 was for treatment plants and industrial wastes control.

The three sewage treatment plants are for primary treatment and they handle 110 mgd. The facilities include screening and grit removal, sedimentation, pre- and post chlorination, separate sludge digestion, elutriation, vacuum filtration and sludge drying. The treated effluent is discharged to the bay and ocean.

The personnel come under job classification and work limits established by civil service rules. The number of employees in each classification is limited by ordinance.

To minimize malingering, a Department of Public Works doctor checks employees reported sick.

The problem of training new employees is said to be difficult, and it apparently has not been solved to the complete satisfaction of management. It has not always been possible to assign new employees starting work with experienced personnel. There have been instances where inexperienced operators have been the cause of damage to equipment.

■ ENGINEERING ASPECTS OF FINANCING SEWAGE AUTHORITY PROJECTS, by Samuel I. Zack, Vice-President of Sanitary Division, Gannett, Fleming Corddry and Carpenter, Inc., Harrisburg, Pennsylvania.

Mr. Zack presented a comprehensive picture of the various methods of financing sewage works, and his paper should be considered a necessary reference by other consulting engineers.

As an illustration of the changes in the costs of financing projects, he said: "Not too many years ago an Authority project was not considered feasible if sewer rentals were more than $24 per year; then this nonfeasible sewer rental figure became $30, then $50. In recent years sewer rentals of as much as $60 to $80 per dwelling unit per year, and more, plus tap-on charges of $50 to $150, and sewer assessments of $5 to $10 per front foot are not uncommon in Authority financing."

■ SEWERAGE AND INDUSTRIAL WASTE PRACTICES OF THE COUNTY SANITATION DISTRICTS OF LOS ANGELES COUNTY, by John D. Parkhurst, Assistant Chief Engineer, Los Angeles County Sanitary District, Los Angeles, California.

Mr. Parkhurst talked on the 19 separate districts of the County each of which is a distinct entity with definite boundaries. These districts serve an estimated 3 million people. To collect the sewage, there are 5,697 miles of lateral sewers, and 750 miles of trunk sewers. The sewage is given treatment in 5 plants, and the sewage originates from 58 incorporated cities and from large tracts of incorporated county areas.

Although the engineering work is centralized in one district, the funds for operation and maintenance are collected from each separate district. In addition, the rate of payment is based on meter readings of the waste flow from each district. The total amount of sewage handled is about 280 mgd.

■ INSURANCE AND ITS PLACE IN SEWAGE WORKS MANAGEMENT, by Ralph E. Roderick, Partner, Cornell, Howland, Hayes, and Merryfield, San Francisco, California.

This is a subject not often covered and, therefore, was of interest to many managers of sewage plants. Mr. Roderick believes that the major problem in buying insurance is determining the amount of coverage the particular municipality should carry. This means, it must be determined what part of the plant would be most likely to suffer a loss of some magnitude resulting from fire, explosion, wind, flooding, or similar forms of physical damage. In addition to having fire and extended coverage insurance, he said, workman's compensation, general liability, and automobile liability should probably be included in the overall insurance program for the treatment plant facilities.

Mr. Roderick also pointed out that there are several types of insurance, and that careful consideration must be given to the selection of the policy that best fits the situation of the particular plant. In many instances, he believes, almost full coverage is carried only because there was no reliable information available which would have helped the plant management select the best policy at the time the insurance was purchased.

It seems that there are numerous ways of reducing the insurance risk and thereby reducing the cost of the insurance. He gave as an example, a situation where the base insurance rate was increased 10 points because the plant's propane gas tank did not have a tamper-proof lid and, moreover, was located within 30 feet of the plant's control building.

Maintenance

■ SEWER MAINTENANCE, by M. N. Lipp, City Manager and City Engineer, Miami Beach, Fla.

In discussing St. Petersburg, Florida, he stated that the only preventative used was applied on the spot where maintenance has been indicated by constant trouble. All other maintenance is just spot correction of the trouble.

The city assumes maintenance up to the property lines. Any stoppages occurring on the property are the responsibility of the property owner. The city is only responsible from the property line on.

The maintenance department is made up of 3 crews, an emergency crew a cleaning crew, and a maintenance crew.

In regard to clearing of lines, the use of chemicals has only proved to be a stop-gap measure. It is still necessary to get to and physically remove the trouble. In the Florida region, all work over 3 feet deep requires the use of well points.

At the end of the working day, the foreman reports on a special form that shows the job done, the equipment used, amount of men used, time tables etc. and all necessary information for a complete cost accounting tabulation to be made.

■ MEASURING DEVICE MAINTENANCE, by R. D. Bargman, Assistant Chief Engineer, Sewage Treatment, Bureau of Sanitation, Los Angeles, Calif.

Personnel is the key part of proper meter or measuring device maintenance. It has been figured out on the basis of 1-man per $30,000 of equipment or, 1-man per 100 instruments.

An average electrician is not qualified to do proper instrument maintenance. He needs electrical knowledge, but he also needs mechanical and hydraulic knowledge. For example; Meter flow control valves, are designed for efficient operation of the meter. No meter will function properly if the control valve is only ⅔rds closed, when it should be fully closed or fully open.

■ COMMINUTOR MAINTENANCE, by N. S. Bubbis, General Manager and Chief Engineer, Greater Winnipeg Sanitary District, Winnipeg, Canada.

In Winnipeg, conditions are probably the most severe that Comminutors can be expected to cope with. The trunk sewers presently intercepted are all of the combined type and laid on very flat grades. Secondly, the long and severe winters require the use of large quantities of sand, cinders and finely crushed stone for ice control on the streets. The majority of this is later flushed down the sewers in the Spring with the Winter accumulation of some 50 in. of snow.

One of the main problems was excessive wear of combs and shear bars. This problem was overcome by using stainless steel instead of mild steel for combs and bars. Another was the excessive wear on the drums, this being due to the heavy grit and rusting. It had been noticed that the greatest wear on the drums took place on the bottom slots decreasing progressively to the top. It was therefore decided that in the case of 15 and 25 in. machines, the drum would be split horizontally into two sections. Thus, whenever a bottom section showed signs of excessive wear, it could be replaced and the old top sections would remain, thus saving the cost of a complete new drum.

All repair work and regular heavy maintenance is carried out at the City of Winnipeg Machine Shops. The work is brought to the shops by two service crews of three men each, who visit each station every day and carry out routine maintenance of all equipment, and a third or maintenance and repair crew of four men who have a hoist equipped truck and other tools required to perform major tasks.

Proper measuring device maintenance requires the services of a specialist.

With other suggestions, Mr. Bargman mentioned that it would be helpful if there were provisions made for the heating of venturi's to eliminate grease problems, thus eliminating the hand cleaning now required.

■ PERSONNEL, TOOLS AND EQUIPMENT FOR SANITARY SEWER MAINTENANCE, by A. E. Holcomb, Asst. Sanitary Sewer Supervisor, Dallas, Texas.

In 1906 the first sewage treatment plant was started in Dallas, now there are approximately 2000 miles of sanitary sewer mains and 169,000 sewer lateral connections. The mains in the system vary from 4 to 90 in, of which 75 percent are in the 6 and 8 in. size group. Fifty percent of these mains were built in the past 20 years. Dallas maintains the lines to the outside edge of the property only.

The personnel in the maintenance section consists of 4 emergency crews; 27 repairs and new service crews; and 7 sewer cleaning crews.

Equipment used in the maintenance section consists of: pipe cutters; dipping needles and pipe locators; manhole blowers; 2-way radios —on 4 emergency trucks and 7 passenger cars plus central dispatcher; sewer maps—94 sheets 20 x 30 in size cover the entire system; sewer cleaning equipment. However, the most important items are modern equipment and properly trained personnel.

■ MAINTENANCE—RECORDS OF LIFT STATIONS AND SEWER MAINS, by Ernest Hamilton, Supt. Sewers and Sewage Treatment, Biykder, Colorado.

The one point that was greatly emphasized by Mr. Hamilton was: Put everything on paper. He then pointed out the example of one man who is still working for the district although he is well past retirement age, and the only reason he is working is that too much information is in his head and not down on paper. It has been estimated that it would take months and months to get the information on valve locations, maps, tie-ins, worksheets, etc., down to readable form, that he now has in his head, and then it probably would not be complete. This points up the fact that everything, no matter how trivial it may seem, should be put down on paper.

The rodding crew and bucket machine crew use a blank block type of record sheet that gives a diagram of the area, and other information such as distances between manholes, depth, conditions, main conditions, and surrounding areas. From these forms, the foreman makes out a daily work sheet that further includes equipment used, materials used, and details of the work done. A colored tape shows work done on a master map in the office. These sheets are then consolidated into an annual report.

Lift stations all contain sheets that show power used; greasing schedules, and any repairs performed; and flow records show gallons pumped.

■ DIGESTION TANK MAINTENANCE, by Donald P. Scott, Deputy Commissioner of Works, Toronto, Canada.

Mr. Scott discussed the problem of scum blanket formation in their digestion tanks. The tanks are 100 ft in diameter, 30 ft sidewall, 12½ ft deep cone and a fixed flat roof. Soon after tanks were placed in operation, the formation of blanket material became evident, in spite of continual recirculation of sludge. After two years, the blankets were not just 6 or 8 ft thick, but 12 to 18 ft thick, and developed at a rate of 6 in. per month.

This rapid and thick blanket development blocked normal overflows and cut the capacity of the plant by 50 percent.

After many experiments, and several manual cleanings of the tanks, it was found that very large volumes of gas recirculation effectively controlled the scum blanket. However, a blanket one foot thick will develop within 4 hours if the compressor is stopped.

A policy of cleaning out each digestion tank after 24 months' operation has now been established. The blanket material, which collects as

soon as the gas recirculation is stopped and during the time the tank is pumped down—approximately 4 ft thick across the whole tank—is hosed to the outlet and filtered.

At the present time new tanks are being built with facilities for utilizing the gas recirculation method, and repairs on tanks damaged by rising blankets are being completed.

Industrial Wastes

■ WASTE CONTROL IN A LARGE WET INDUSTRY LOCATED ON A SMALL WATERCOURSE, by Frank J. Coogan; Assistant to Division Industrial Engineer, Southern Kraft Division, International Paper Co., Mobile, Alabama.

Good public relations was the keynote of this paper which described the disposal of strong pulp wastes into a stream of very low seasonal flow. The Kraft pulping operation at International's plant includes mechanical bark removal, chipping into ½ to 1-inch chips, digesting with a strong caustic-sulfide solution, recovery of turpentine from exhaust vapors, washing and bleaching of the cooked fibers. The spent cook liquor is evaporated from 16% to 50% solids, and is then burned to recover cooking chemicals. Reduction by carbonaceous material during the burning re-converts the sodium sulfate in spent liquor to usable sodium sulfide; and addition of lime regenerates caustic soda from the sodium carbonate content of the used liquor. The chemical recovery is thus reasonably efficient, which is essential to the process economy as well as to the abatement of stream pollution.

The bleaching process produces the worst from the viewpoints of B.O.D. and color. Wastes from the entire plant are collected and stored during periods of low stream flow, and are discharged during the wet season. The first release of wastes from lagoons is at a low rate, causing the fish to migrate to more favorable waters during this operation; a sudden release might cause a kill instead. Release is then regulated to maintain 2.5 mg/L DO in the downstream bayou. Studies have shown that the waste has no ill effects on field crops or on cattle, except a possible slight effect when used by cattle for drinking in undiluted form. The waste is used to flood a state-operated duck preserve; this water makes the preserve possible and is appreciated by the citizens of the surrounding area.

■ ECONOMIES IN METAL FINISHING WASTE MANAGEMENT AT APPLIANCE PARK, by C. M. Fair; Superintendent of Water Management and Waste Control, General Electric Co., Louisville, Ky.

■ The control of 5.5 million gallons per day plating wastes is described. Cyanides are destroyed by chlorination, chromates by reduction with SO_2, and acids by neutralization. Treated wastes are blended, and discharged to the municipal sewer. The cost of treatment is computed to be 18 cents per 1000 gallons, including amortization.

Water management is a major economy at Appliance Park; this refers to the planned use and re-use of water. The water supply is separately metered to each building, and sometimes to individual processes. Automatic control of water is used when possible, for example conductivity meters are installed in rinse tanks to regulate the flow of dilution rinse water.

Spent acid is recovered for several further uses, instead of being neutralized for disposal. Some dilute sulfuric acid is utilized in the treatment and pH control of plant cooling water. Waste acids are also useful in chrome waste reduction and in other applications. A mixture of spent nitric and phosphoric acids has been saleable to a near-by fertilizer plant.

In general, this plant produces an excess of acid waste, hence alkalies are required for neutralization. The source of alkali has been changed from purchased lime to locally produced acetylene sludge. This is available as a 40% slurry, which is hauled by tank trailer and stored in an agitated tank.

Further miscellaneous economies include the recovery of oily wastes for sale or use as incinerator fuel, the filtration of plating solutions to prolong their lives, and continuous monitoring to detect leaks.

■ POLLUTION ABATEMENT IN THE SUGAR CANE INDUSTRY OF LOUISIANA, by Arthur G. Keller, Professor of Chemical Engineering; and H. K. Huckabay, Graduate Assistant, Engineering Experiment Station, Louisiana State University, Baton Rouge, Louisiana.

The cane sugar industry of Louisiana is markedly seasonal, operating only 60 to 70 days per year, in contrast to the year-long activities in Hawaii and many foreign countries. The industry also involves a large number of small plants, some 48 in Louisiana alone. Waste disposal is a problem because of the low flow velocity in the bayous; the flow may even reverse its direction from day to day. Septic conditions in the bayous are not unusual, due to municipal sewage as well as industrial waste.

The major pollutant of the sugar industry is cane wash water, because of its high dirt content and B.O.D.

The industry has supported university research for several years, including plant surveys, analytical methods, and treatment techniques. There is much recycling of process water, and impoundment of concentrated wastes. Areas for holding the waste are inadequate in some locations, and some promise of pollution abatement is shown by short-time (2 to 4 days) lagooning.

■ CONTROL PROBLEMS USING ORP IN CHROMATE REDUCTION, by Glen E. Summers, Industrial Water Service Engineer, Boeing Airplane Co.

The use of oxidation-reduction potential to control the ozonation of cyanide has been reported previously. This paper reports on the reduction of chromate wastes by sulfur dioxide, at pH 2.5. After reduction, the pH is raised to 7.4 by means of lime slurry, thereby precipitating the trivalent chromium as $Cr(OH)_3$. After removal of the precipitate, the effluent is blended with other chromium-free wastes, and is oxidized with ozone to reduce the chemical oxidation demand from about 30 mg/L substantially to zero. The ORP control range for chromium reduction is +160 to +200 millivolts (Platinum-calomel electrodes).

Unit Processes

■ SLUDGE FILTRATION by E. H. Trubnick, Komline-Sanderson Engineering Corp., Peapack, N. J.

This paper was preceded by the showing of a group of historical slides on early sludge disposal experiments carried on by T. R. Komline. Sludge disposal equipment should be sufficiently durable to last out the bond issue and according to Mr. Trubnick, development of vacuum filters in the last ten years have included designs which will do this. Consideration of sludge disposal as a unit process, including positive displacement pumps, chemical feeders and vacuum filters has followed the understanding of sewage sludge's chemical characteristics. Fresh sewage solids dewatering is on the increase, since the early installation in 1953 at St. Charles, Ill. The cake did not create a nuisance following its use as fill in a ravine. Savings up to 15% on the capital investment and 27 to 57 cents per capita per year in operating costs have been realized in eight installations.

■ INCINERATION OF SEWAGE SLUDGE, by Mr. C. A. Leet, Jr., Combustion Engineering Corp., Chicago, Illinois.

The application of thermal principles to the drying and incineration of materials of a uniform and stable composition is fairly simple. However, it can certainly be agreed that sewage sludge is neither uniform nor stable. It is a complex material of animal, vegetable and mineral content in any and all proportions. Variations in these proportions affect the filtration characteristics so that filter cake from vacuum filters can vary in moisture content over wide ranges. It is the moisture content which can affect the performance of drying or incinerating equipment, whether the ultimate aim is to dry sludge for use as a soil conditioner or to incinerate it to a sterile ash. This is commonly referred to as the evaporation load, particularly important when drying equipment is to be used for soil conditioner production. When incineration to a sterile ash is required, heat release in the furnace becomes equal in importance to the evaporative load.

Mr. Leet referred to the stringent air pollution codes requiring compliance whether drying or incinerating sewage sludge. Both fly ash and odors must be controlled in order for equipment to meet these codes. Control equipment is available as dry collectors, wet scrubbers, or high temperature deodorization, which becomes economical when a heat recovery device is employed. Examples of heat balance calculations and a mathematical study was provided. Gases evolved from the process must be dispersed in accordance with prevailing wind direction using stacks between 75 and 350 feet high.

■ WET OXIDATION OF SEWAGE SLUDGE, by Mr. E. Hurwitz, Met. San. Dist., Chicago, Illinois.

Population increase, with resultant increase in sludge volume, had dictated that the District find means other than lagooning to solve the disposal problems. It was decided to use the wet-air oxidation method (Zimmerman Process) to handle in excess of 200 tons/day for this purpose. The physical units of this plant are an air compressor, a sludge pump, a reactor and a series of heat-exchangers to recover energy developed by the wet-burning of the sludge. The selection and sizing of these elements are the problems to be solved for the design of a plant using the principle of wet-air oxidation for ultimate disposal of sludge. Liquid pumping units are selected by the conventional parameter of volume of sludge to be treated. The size of the reactor depends upon the volumetric load, the desired operating temperature, the chemical oxygen demand (COD) of the sludge entering the reactor, and the degree of COD reduction desired. In order to test the suitability of the method for its needs The Metropolitan Sanitary District of Greater Chicago operated a pilot plant designed to handle 2 tons/day. Operated for one year, the plant made 20 runs extending in duration from 20 to 361 hours. The pilot unit is 24 in. dia and approximately 30 ft high. Within the ranges of the volatile solids concentrations studied, the reduction of oxidizable material as measured by the COD was 79%. The amount of volatile solids destroyed was 89%. Total solids reduction averages 67.3%. The results indicate that degree of sludge degradation is a function of temperature and does not vary appreciably percentagewise, from solids concentration variation.

The effluent is characterized by high ammonia and high volatile acid resulting from the oxidation of the nitrogen and carbon constituents of the sludge. BOD of the effluent ranged from 5400 to 8400 ppm and represents a reduction of 60% from the BOD of the original liquid sludge. The settleable ash is 10-12% of the volume after one hour settling. The residual COD left in the ash from one liter of effluent ranged from 1900 to 5000 mg and BOD from 530 to 1350 mg. The volatile content of the dried ash ranged from 13 to 17% with an average of 15%. The mineral content is similiar to that in ash from a highly industrialized area, however it is sterile and biologically stable. Exhaust gases consist mainly of nitrogen and carbon dioxide, with residual oxygen and a trace of hydro-carbons, there is no fly ash or other air pollutant.

■ HYDRAULIC LOAD, ORGANIC LOAD AND EFFICIENCY IN TRICKLING FILTERS by Dr. K. L. Schulze, Michigan State University, East Lansing, Michigan.

An experimental filter consisting of seven vertically suspended wire screens arranged in parallel and spaced two inches apart was used in this study. For experiments on the effect of increasing organic loads, the hydraulic load was kept constant and the incoming BOD was increased by adding whey to presettled sewage which served as basic feed to the filter. In order to study the effect of increasing hydraulic loads, the settled sewage was used with step-wise pump rate increments. Data collected refer to percent removal effected through the filter and final settling tank. It was found that organic load did not greatly affect filter efficiency, but that hydraulic loading could be a controlling factor in filter design. It was noted that depth and temperature must also be considered. The experiments included application of the data to determine the effect of recirculation. Dr. Schulze concludes that the gain in dilution of incoming BOD is lost by the decrease in efficiency due to the higher hydraulic load. Also, he finds the trickling process similar to an absorption process where hydraulic load determines contact time and this in turn determines the level of efficiency at which the process operates.

Combined Treatment

■ SOLVING SOUTH CHARLESTON'S WASTE PROBLEMS THROUGH THE COMBINED APPROACH.

Background of the Combined Approach as Viewed by Industry.

By George P. Schrader, Project Engineer, Union Carbide Chemicals Co., South Charleston, W. VA.

The South Charleston Sewage Collection System and Treatment Works.

By J. K. Latham and J. W. Finney, Partners in Howard K. Bell Consulting Engineers, Lexington, Ky.

These twin papers described a joint venture in waste disposal, established by the City of South Charleston, West Virginia, and the Union Carbide Chemicals Company. Both the city and the company were under separate orders to clean up the Kanawha River, and chose a joint treatment works as the optimum solution.

Among the reasons for combined plant are: less initial capital investment, lower operating costs, and reduced nutrient requirements for the industrial wastes. The latter are very complex, comprising over 400 different chemical materials, produced on a schedule that varies from day to day. A large pilot plant was built in 1954, and has been operated on these wastes with several types of process. Activated sludge was selected as the most satisfactory process, although acclimation of the microorganisms needs attention.

An overall BOD reduction of 42% is required by the State Water Resources Commission. This is accomplished by primary treatment of the total waste, and secondary treatment of one-third of the waste. Activated sludge treatment of a second one-third is expected to yield 67% overall BOD reduction if this degree of treatment becomes necessary; complete secondary treatment will give 92%.

Control of pH is essential, and the range from 6 to 9 is best. Raw industrial waste fluctuates from 1 to 13, and may change by a whole pH unit within one minute. There is no space for adequate equalizing lagoons, so control must be by acid or alkali additions to the flowing stream. The final sludge is thickened to 4 to 6 percent solids, filtered, and disposed of on waste land.

■ COMMUNITY TREATMENT PLANT FOR UPPER POTOMAC RIVER, by Richard Hazen, Partner, Hazen and Sawyer, New York, N. Y.

A treatment plant now under construction on the upper North Branch of the Potomac River will handle both industrial wastes and the sewage from several small communities. This is an unusual situation in that the project has been financed by public authority, the Upper Potomac River Commission. The project includes a one-mile 54-inch sewer to transport paper pulp mill wastes (completed), a sewage collecting system, and a 21 mgd activated sludge plant for the combined wastes.

The activated sludge plant includes a primary clarifier, three aeration tanks, two final clarifiers, and a sludge thickener and filter. Turbine aeration is used instead of the more usual diffusers. Raw sludge, after dewatering, will be trucked to an abandoned strip mine for disposal. Supplementary phosphorous and nitrogen nutrients will be needed for the activated sludge process, as municipal sewage comprises only about five percent of the flow.

In addition to the pulp wastes, the company has paper mill wastes which are high in suspended solids but fairly low in B.O.D. A 6 mgd clarifier has been constructed for pretreatment of these wastes before discharge to the trunk sewer.

Waste Disposal

■ SUBSURFACE DISPOSAL OF SALT WATER IN EAST TEXAS OIL FIELD, by Mr. W. S. Morris, East Texas Salt Water Disposal Co., Kilgore, Texas.

Nearly two billion barrels of salt water have been injected over a 17 year period into the lower portion of Woodbine sand. This lies 3800-3900 ft. below the East Texas Oil Field. The injection facilities include gathering lines of 400 miles of asbestos-cement pipe, 36 treating plants and 60 injection wells. The program grew out of the necessity to eliminate salt water contamination of the watershed and pollution of the streams flowing through the area. A secondary benefit has been the maintenance of pressure in the oil-bearing reservoir, minimizing the necessity of mechanical oil pumping.

■ MARINE WASTE DISPOSAL SYSTEMS by Dr. E. A. Pearson, University of California Berkeley, California.

Dr. Pearson stated that the effects of wind, waves, currents, and the aquatic environment on Marine Waste Disposal, are not clearly understood. In addition to rapid and thorough mixing, such factors as beneficial uses of water, water quality criteria, mass circulation, summary of current patterns and use of an eddy diffusivity coefficient should be considered in the final location of the disposal outfall. Inflow and outflow of ground water is important and has been generally overlooked. Waste concentration, volume and residence time are essential to enable regulatory agencies to apply limits and control measures.

■ FORECASTING HEAT LOSS IN PONDS AND STREAMS, by Dr. C. J. Velz, University of Michigan, Ann Arbor, Michigan.

This study provides useful information to power utilities and operators of nuclear reactors, particularly with respect to disposal area tolerances and determining water temperature profiles. Stream gaging techniques were used to collect the data. Heat loads from steam generating stations vary widely, though 4400btu/Kw is a commonly used figure. Heat is also added and subtracted throughout the meteorological cycle, evaporation, convection, radiation and cannot be calculated. It is possible to measure the impact of clouds, trees, air pollution blankets, and other local phenomena at the disposal site and along the water course. Use of long term weather station information enables one to arrive at statistical most probable monthly mean temperatures at the site. This is also true of monthly wind velocity and vapor, though not of solar radiation, due to the lack of adequate records. This type of disposal program must consider effects due to the hydrologic cycle, because of the impact of minimum conditions during drought.

Suspended Solids Concentration in Activated Sludge, its effect on . . .

Sludge Volume Index

by E. ISENBERG and H. HEUKELEKIAN,
Rutgers Univ., New Brunswick, N. J.

EDITOR'S NOTE: If suspended solids concentrations are kept constant, only changes in sludge density will affect sludge volume index. Variations of sludge volume index increase with decreasing sludge density mostly because of suspended solids. These conclusions are supported by experimental data.

This is a paper of the *Journal Series, New Jersey Agricultural Experiment Station*, Rutgers Univ., The State Univ. of New Jersey, Dept. of Sanitation.

■ USE OF ACTIVATED SLUDGE for sewage treatment depends on its purifying ability and on its settleability. One of the control measures of settleability is the sludge volume index, which expresses the volume occupied by one gram of dry sludge after settling for 30 minutes in a liter-graduated cylinder[1]. A decrease in sludge density is reflected by diminished settleability, greater settled volume per unit weight, and higher sludge volume indices.

Research carried out by several workers indicates that factors other than sludge density affect the settling rate and final settling volume. Clifford and Windrige[2] found that increasing sludge concentration produced more than a proportionate increase of sludge volume. They also found that vessel diameter did not affect the settling rate of various sludge concentrations. Rudolfs and Lacy[3] noted retarded settling rates when the solids concentration increased from 800 to 5000 mg/L. The diameter of the container did not affect the percent volume occupied by a given sludge after 30 minutes of settling. Fitch and Ives[4] suggest that high solids concentration would compact in the settling cylinder and thereby result in a lower index value. Evidence showing the magnitude and direction of change on sludge volume index values does not exist in the literature.

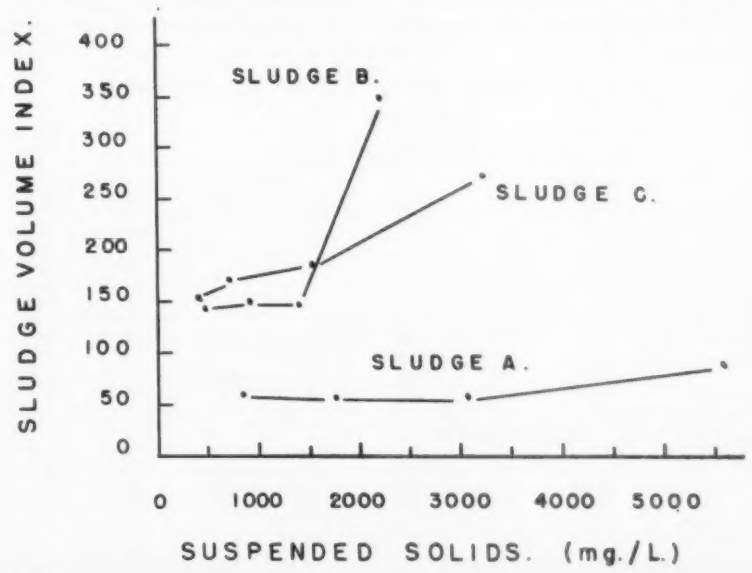


FIG. 1—INCREASING sludge volume index with increasing suspended solids.

Before the effect of suspended solids concentration on the sludge volume index could be studied, it was necessary to determine the precision of sludge volume index values. In experimental work, where the quantity of mixed liquor available is limited, samples smaller than one liter would be desirable. Comparisons were, therefore, made between sludge volume index values using 500 and 1000 ml. graduated cylinders.

Procedure

Activated sludge samples were obtained from three New Jersey sewage treatment plants. Sludge volumes, after 30 minutes settling, and suspended solids were determined on four concentrations of either mixed liquor or return sludge. Concentrations of sludges B and C, known for their high sludge volume indices, were prepared by diluting return sludge with plant effluent. Sludge A was prepared by settling mixed liquor and decanting the supernatant. Each concentration was settled for 30 minutes in 500 and 1000 ml. graduated cylinders. The same sample of activated sludge was used for the four concentrations and two cylinder sizes. Suspended solids were determined with Gooch crucibles for each concentration. Both the 30-minute settling volume and suspended solids determinations were carried out in ten replications.

Results

Sludge volumes, after 30 minutes settling, with varying suspended solids concentrations for the ten replications, are averaged and summarized in Table 1. Standard deviations computed as a percent of the mean, result in a coefficient of variation, which then enables comparisons of precision between means of different magnitudes. Results shown are averages of

ten replications and their coefficients of variation. It should be noted that half as much sludge was settled in the 500 ml. cylinder as in the 1000 ml. cylinder. The volumes settled in the smaller cylinders were, therefore, multiplied by two for comparisons with volumes settled in the larger cylinders.

Greatest variation was found in suspended solids determinations, where the average coefficients of variation ranged from 2.1 to 7.1 per cent, with an overall average of 4.9 per cent. Variations in 1000 ml. settling volumes (2 per cent) were slightly less than the variations in 500 ml. settling volumes (3 per cent); the overall variation in settling volumes for both sizes of cylinders were less than the variations in suspended solids determinations.

A sludge volume index value is calculated as the ratio of settling volume to suspended solids. The coefficient of variation of the index is the square root of the sum of the squares of settling volume and suspended solids coefficients of variation[5]. These calculated results are shown in Table 2. Comparison of average index values for the two cylinder sizes indicate no statistically valid difference. These are combined into a 20-replicate average, with recalculated coefficients of variation. A graphical representation of these results is shown in Figure 1. Significant changes in sludge volume index occurred when more than 3000 mg/L suspended solids of sludge A were used in the settling test. The index value rose from 60 to 92. With poorer settling sludges, as sludges B and C, significant increases of index values occurred with much lower suspended solids concentrations. While the index number increased at 3000 mg/L of sludge A, only 1500 mg/L of either sludge B or C caused similar increases in index values. Sludge B index rose from 147 to 351 when the solids concentration increased from 1426 to 2237 mg/L. Sludge C index rose from 150 to 277 when the solids concentration increased from 427 to 3244 mg/L. A general decrease in precision of the sludge volume index was noted as the sludge density decreased. The average coefficients of variation increased from 5.1 to 6.5 to 7.6 per cent with increasing bulkiness.

Over the range of suspended solids concentration used in this study, there was no indication of compaction or lower indices with increasing solids concentration. Calculation of results presented by Clifford and Windrige[2] reveal that compaction phenomena may occur with very high solids concentration. Table 3 shows that with "ordinary" activated sludge, compaction was noted at 3160 mg/L and higher; whereas, with "reconditioned" sludge it was noted at 8790 mg/L and higher.

Table 1

Coefficients of Variations of Suspended Solids and Sludge Volume Determinations with Different Mixed Liquor Concentrations

Location	Suspended Solids mg/L	C.V.[2] Per cent	Graduated Cylinder Size 500 ml. Sludge Volume[1] ml/L	C.V.[2] Per cent	1000 ml. Sludge Volume[1] ml/L	C.V.[2] Per cent
Sludge A	851	3.4	52	3.1	50	0.9
	1767	1.9	101	3.0	100	1.3
	3049	1.1	177	3.2	185	2.0
	5676	1.3	481	4.3	555	6.2
Average		2.1		3.4		2.6
Sludge B	477	5.7	70	0.9	69	4.9
	921	4.8	140	2.6	138	3.3
	1426	6.1	207	3.3	212	2.2
	2237	3.2	776	4.0	796	2.7
Average		5.5		2.7		3.3
Sludge C	427	10.4	67	4.0	61	1.3
	743	5.8	124	2.9	124	3.2
	1550	5.2	280	4.7	286	1.5
	3244	5.6	901	3.1	897	1.6
Average		7.1		3.7		1.9
Overall Average		4.9		3.3		2.6

1. after 30-minutes settling
2. coefficient of variation

Discussion

Significant changes in sludge volume index occur with increasing suspended solids concentration. Good settling sludge, as A, showed an increased index value from an average of 59 in the range of suspended solids of 851 to 3049 mg/L to sludge volume index of 92 at 5657 mg/L. This increase of 33 index units is equivalent to 54 per cent of the average value of 59. Greater percentage increases of sludge volume index were found with poor settling sludges. Sludge B index value rose from 147 to 351 when the suspended solids increased from 1426 mg/L to 2237 mg/L. This was a 138 per cent in-

Table 2

Calculated Sludge Volume Indices with Increasing Suspended Solids

Location	Suspended Solids mg/l	Graduated Cylinder Size 500 ml. SVI[1]	500 ml. CV[2]	1000 ml. SVI[1]	1000 ml. CV[2]	Average SVI[1]	Average CV[2]
Sludge A	851	61	4.6	59	3.5	60	4.5
	1767	57	3.5	57	2.3	57	3.0
	3049	58	3.4	61	2.3	60	3.6
	5657	85	4.5	98	6.3	92	9.2
Average							5.1
Sludge B	477	147	5.8	144	7.5	145	8.9
	921	152	5.4	150	5.8	151	5.6
	1426	145	7.0	149	6.5	147	6.8
	2237	347	5.1	356	4.2	351	4.8
Average							6.5
Sludge C	427	157	11.1	142	10.4	150	11.5
	743	167	6.4	167	6.6	167	6.5
	1550	181	7.0	184	5.5	183	6.3
	3244	278	6.4	276	5.8	277	6.1
Average							7.6

1. SVI=sludge volume index
2. CV =coefficient of variation as percent

Table 3

Changes in Sludge Volume Index Caused by Increasing Suspended Solids*

Type of Activated Sludge	½ h. Settling ml/L Volume	Suspended Solids mg/l	Sludge Volume Index
"Ordinary"	40	520	77
	110	1050	105
	190	1580	120
	260	2100	124
	340	2630	129
	870	3160	275
	920	3680	250
	930	4210	221
"Reconditioned"	130	1760	74
	310	3520	88
	480	5270	91
	820	7030	117
	910	8790	104
	950	10,550	90
	960	12,300	78
	980	14,060	70

*Calculations based on results given by Clifford and Windrige[2]

crease over the index value of 147. With sludge C there was an 85 per cent increase of index value. When the solids concentration increased from 427 to 3244 mg/L, the index rose from 150 to 277.

These results, which cover the range of suspended solids normally used in sewage treatment practice, indicate no compaction phenomena. Calculations made on results presented by Clifford and Windrige, however, show that compaction may occur. A good in 30 minutes settling sludge of about 74 sludge volume index, showed compaction when the solids concentration was over 8000 mg/L. Activated sludge of about 120 index began to compact in the settling cylinder when the solids concentration was greater than 3000 mg/L.

These marked changes in sludge volume index caused by different solids concentration, indicate that the precision of the test can be increased significantly. By using 1000-1500 mg/L suspended solids, for all types of activated sludges, the test can be made more precise. In this manner, only changes in sludge density will be reflected by changes in sludge volume index.

Examination of the coefficients of variation in Table 2 indicates decreasing precision or wider variations with poorer settling sludges. The average coefficients, omitting the highest sludge concentration, for the three characteristic sludges, are shown in Table 4. These range from 3.7 to 8.1 per cent as the index increases from 59 to 167.

The variations in sludge volume index can be attributed to the variations in suspended solids determination. Variation in settling volumes remains essentially the same with increasing sludge volume index. Well-defined trends in variation with increasing solids concentration for one particular sludge are not evident. Generally, however, less variation occurred with higher solids concentrations.

For sludges of about 60 sludge volume index, we may predict with a high degree of certainty that differences greater than 7.4 per cent are significant. When the test is performed with from 1000 to 1500 mg/L suspended solids, sludge concentration will not affect the sludge volume index. Then, if under two sets of activiated sludge operating conditions a difference in sludge volume index of 10 is found (e.g. index values of 55 and 65), this difference could not be due to chance. That is, we may predict with 95 per cent probability that a difference of 10 index units, as above, was not due to chance or to the variability of the index test, but was due in fact to the different operating conditions. For sludges of 150 and 170 sludge volume index, the ranges of reliability are wider. Table V shows the per cent variation and range of values expected for the three sludges investigated.

The overall average 30 minute settling volume coefficient of variation for 1000 ml. graduated cylinders was slightly lower than for 500 ml. cylinders. The difference, however, was not significant and the two cylinder sizes may be used interchangeably.

Table 4

Effect of Sludge Volume Index on the Precision of the Test

Sludge	Suspended Solids Range mg/L	Average Sludge Vol. Index	Average Coefficient of Variation Per cent
A	800-3000	59	3.7
B	500-1400	148	7.1
C	400-1400	167	8.1

Summary and Conclusion

1. Thirty minute settling volumes and therefore sludge volume index values are affected significantly by concentration of suspended solids. Increased precision of sludge volume index determinations, as a control measure of sludge density, can, therefore, be obtained by using from 1000 to 1500 mg/L suspended solids. Only changes in sludge density will affect sludge volume index when suspended solids concentration are kept constant.

2. Variations in measures of sludge volume index increase with decreasing sludge density. Most of this increasing variation is caused by suspended solids, and not by 30-minute settling volume determinations.

3. Precision of the test and range of sludge volume index values expected for various activated sludges are shown.

4. Graduated cylinders of 500 or 1000 ml. size may be used interchangeably as no significant difference in sludge volume index was found.

References

1. *Standard Methods for the Examination of Water, Sewage and Industrial Wastes. Tenth Edition*, 1955.
2. *Clifford and Windrige, Proc. Inst. Sew. Purif*, 115 (1932).
3. *Rudolfs and Lacey, Sewage Works Journal*, 6, 647 (1934).
4. *Fitch and Ives, Sewage and Industrial Wastes*, 22, 833 (1950).
5. *Benedetti-Pichler, Ind. & Eng. Chem.*, Anal. Ed., 8, 376 (1936).

Table 5

Percent Variation Expected at Different Levels of Sludge Volume Index

Sludge Volume Index	Variation at 95 Per cent Level Per cent	Range Expected
60	± 7.4	56 to 64
150	±14.2	129 to 171
170	±16.2	144 to 196

Red water, scale formation or corrosion problems can be corrected or measurably helped by . . .

Feeding Glassy Phosphates

by HENRY F. MUNROE,
Sanitary Engineer, B-I-F
Industries, Providence, R. I.

EDITOR'S NOTE: This paper presents a brief review of how glassy phosphates are manufactured, their uses, and how they are fed into the water system.

■ WATER, the universal solvent, does not exist naturally in the chemically pure state. It contains dissolved solids or total solids which may vary from a few mg/L up to 75,000 mg/L; the usual range for drinking water being 100 mg/L to 750 mg/L. Surface water usually has a total solids content near the lower end of the scale while underground or well supplies often are quite high in dissolved solids. The solubility of the various ions present in water is governed by such items as temperature, acidity or alkalinity, pH, and dissolved gases. A change in any one of these factors will cause a corresponding change in the solubility of the minerals in the water.

Three ions usually found in water and particularly affect solubility are: 1) iron, 2) calcium, and 3) magnesium. Certain changes in the water carrying these ions can cause them to become less soluble, a condition which in turn gives rise to red water and scale problems. These problems and others can often be avoided by the introduction into solution of glassy phosphates.

Glassy phosphates are produced by fusing a food grade of phosporic acid with soda ash at high temperatures to produce a clear, transparent non-crystalline solid which is sold as broken glass, beads or in the granular or powdered form. Bulk density depends on the form and varies from 100 to 120 pounds per cubic foot.

Red Water

The problem of red water is caused by a high content of iron in the trivalent (+3) state. Iron of this valence will form compounds which are quite insoluble and precipitate out, giving the water a red appearance. There are two common sources of this iron, one from the raw water, the other from the iron transmission pipes.

Water near the bottom of deep reservoirs or in the ground can pick up a great deal of iron in the soluble, ferrous, or divalent (+2) state, due to anaerobic bacterial reduction of ferric (+3) iron. When this ferrous iron comes in contact with any oxidizing agent, oxidation to ferric iron occurs and red water results. Another source of iron is from the corrosion of iron pipe. During the corrosion reaction, iron pipe in the zero valence state is oxidized to the soluble ferrous iron state and goes into solution. This represents the loss in weight during corrosion. Under oxidizing conditions, this ferrous iron will be converted to ferric iron and cause red water.

Both of these conditions may be retarded and even entirely eliminated by the addition of the phosphate before the oxidation takes place. The glassy phosphates will sequester iron and other compounds, but only in the divalent state. This means that the phosphates must be added to the water supply directly at the pump and certainly before chlorination so that the divalent ferrous iron is sequestered. Usually, an amount of the phosphates equal to 3 to 4 times the concentration of the dissolved iron will give sufficient sequestration. The ability of the phosphates to sequester varies with the age, the temperature and the concentration of the phosphate solution.

Scale Formation

Scale in pipes or boilers is caused by the water becoming supersaturated with calcium or magnesium ions, resulting in precipitation as calcium or magnesium carbonate. This supersaturation is often caused by an increase in water temperature. The scale reduces carrying capacity of mains and reduces heat transfer in boilers. The formation of calcium or magnesium scale deposits is prevented by the so-called threshold treatment. The mechanics of this reaction are somewhat similar to sequestration of iron; i.e. the phosphate actually removes the crystal nuclei from solution before its dimensions have reached the proportions of even the colloidal state. This prevents the crystals from growing and becoming insoluble. In most cases, the application of 1 to 2 mg/L of the phosphate is sufficient to prevent scale formation.

Corrosion

While not connected with the solubility of ions, corrosion is a real problem to the maintenance of water pipes, a problem which can be combated through the use of glassy phosphates. Corrosion, defined as the loss of metal into solution, is caused by galvanic action. Some change in conditions along the length of pipe causes the formation of an anode and cathode in the pipe. Electrons flow from the anode to the cathode causing the iron at the anode to be oxidized from zero valence to soluble plus two valence and go into solution. The electrons at the cathode reduce hydrogen

ions in the water to atomic hydrogen which combines with the dissolved oxygen in the water to form water (at most pH's).

Addition of the glassy phosphates to the system causes a complex (calcium-corrosion products—phosphates) to form. This complex plates out on the cathodic areas of the pipe in a very thin, but continuous covering. This layer of the complex prevents the oxidation of hydrogen ions, therefore prevents the flow of electrons, stops the corrosion reaction, and is called polarization of the cathode.

Small amounts (2 mg/L) are normally fed to give protection. The calcium content must be at least ¼ of the amount of the phosphates fed in order to obtain good protection. Larger amounts of phosphates are fed at the beginning until a residual of approximately 0.5 mg/L is obtained at the end of the system. Amounts are then gradually decreased until 0.5 mg/L is maintained throughout. The need for larger amounts at the beginning is caused by the absorption of some of the phosphates by the tubercles and other deposits in the pipe line. Final concentration depends on the flow rate throughout the distribution system; large amounts being used for lower flows. This is directly related to turbulence. At higher flows turbulence is created, physically bringing the complex into contact with the cathodic areas, so lower phosphate doses can be used. Even the larger amounts have no effect on taste and odor. The protection is not only carried through the distribution system but into the consumers piping as well.

Feeding Phosphates

Solution Strength

One pound of glassy phosphate per gallon of solution is the recommended solution strength. Above two pounds per gallon the solution becomes syrupy and sticky, thus difficult to handle. While solutions as strong as 5 pounds per gallon have been prepared, a more detailed solution preparation procedure is necessary and it is standard practice to limit the solution strength to an absolute maximum of two pounds per gallon. In addition, the glassy phosphates revert to ortho-phosphates (non-sequestering) with an increase in temperature or concentration or a decrease in pH. Usually, larger storage volumes are provided rather than to take the time and effort necessary to prepare more concentrated solutions.

Solution Preparation

Standard procedure is to place the sheets or beads in a stainless steel basket of ⅛" mesh with a means of suspending the chemical just below the water level. Another method is to weigh the phosphate directly into a cloth bag and suspend the bag and contents just below the water surface, as shown in Fig. 1. The phosphate will then dissolve in cold water. After it is completely dissolved, a short stirring or the use of a forceful stream of water to bring the level up to the required volume is sufficient for mixing. For preparing a solution from the granular or powdered forms, it is desirable to sprinkle the phosphate into a rapidly agitated volume of cold water. After the solution is completely formed, the volume should be brought up to the mark. In all cases, cold water is used since the phosphate reverts to another form very rapidly at higher temperatures and with age. The other forms of phosphates do not have the sequestering ability of the glassy phosphates.

Contrary to the situation existing with most chemicals, the sheets or beads of the glassy phosphates are easier to put into solution than the powder or granular forms. This is because the powder or granules tend to cake when added to water and these blobs of chemical are hard to disperse and put into solution. The beads or broken sheets, on the other hand, will quickly go into solution if hung in the water. Sometimes these broken sheets are stirred into solution. As a safety precaution the hand should *not* be used for the stirring.

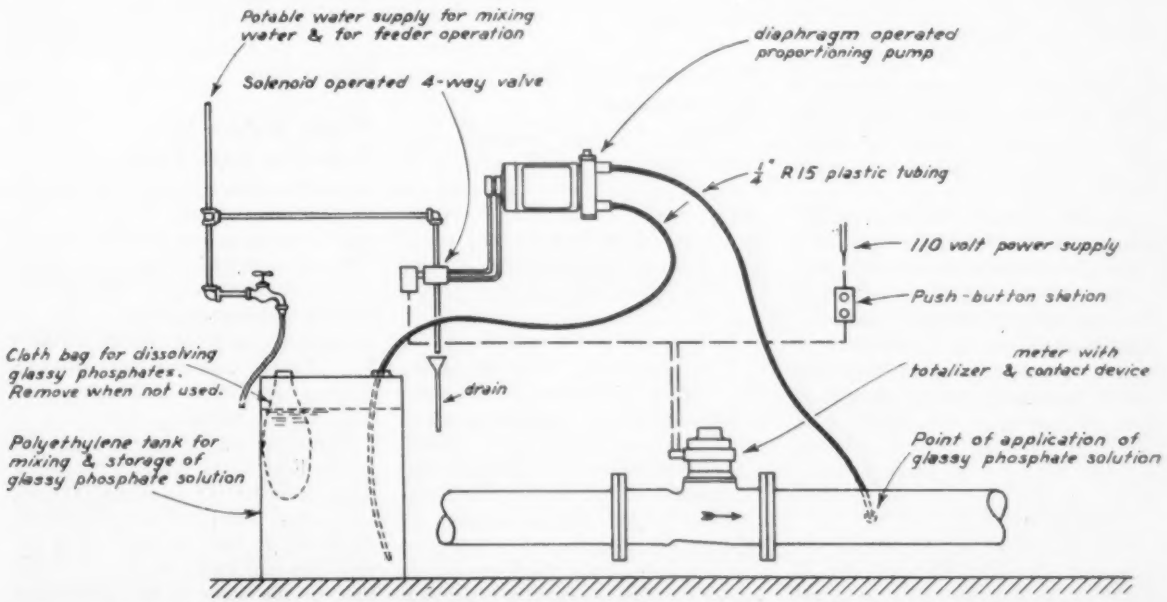

Potable water supply for mixing water & for feeder operation
Solenoid operated 4-way valve
diaphragm operated proportioning pump
¼" R15 plastic tubing
110 volt power supply
Push-button station
meter with totalizer & contact device
drain
Cloth bag for dissolving glassy phosphates. Remove when not used.
Polyethylene tank for mixing & storage of glassy phosphate solution
Point of application of glassy phosphate solution

FIG. 1. A TYPICAL SYSTEM lay-out for feeding glassy phosphates.

Table I
Feeding Glassy Phosphates to Obtain a Dose of 1 mg/L

Rate of Flow	Feed Rate		
	½# Gal. Solution	1# Gal. Solution	2# Gal. Solution
50 G/M	3.16 ml/min.	1.58 ml/min.	— ml/min.
100	6.32	3.16	—
200	12.64	6.32	—
300	18.96	9.48	—
400	25.28	12.64	—
500	31.60	15.80	—
1000	63.20	31.60	—
1500	94.80	47.40	—
2000	126.40	63.20	31.60
2500	158.00	79.00	39.50
3000	189.60	94.80	47.40
4000	—	126.40	63.20
5000	—	158.00	79.00
6000	—	189.60	94.80
7000	—	221.20	110.60
8000	—	252.80	126.40
9000	—	284.40	142.20
10000	—	316.00	158.00

If the hand is used, it may become severely cut and the cuts will be painful and slow to heal.

Feeders

Solutions of unadjusted phosphates, are usually acid in character and rapidly attack iron, steel, copper and brass. While glassy phosphates can be made less corrosive by adding an alkali such as caustic soda or soda ash to a pH of 8.0 or higher, the use of stainless steel or plastic in the construction of feeders and piping from ervoirs should be all plastic, plastiction point is preferred. Solution resthe solution container to the injeclined or stainless steel.

Plunger or diaphragm pumps of the proper resistant construction are available for feeding a wide range of glassy phosphate volumes. The use of a diaphragm feeder completely eliminates stuffing box difficulties. Table I shows typical ranges of feed rates for various flows and dosages.

Typical Installation

A typical small, individual installation is shown in Fig. 1. The problem existed at a country club using city water which came from a well supply. The pH of this water was 6.3. Copper pipe corrosion as well as clogging of shower heads was present. Problem was corrected by the use of glassy phosphates. This installation has enjoyed three years of trouble-free operation and there has been no reoccurrence of the problem. The one lb./gal. feed solution is fed in proportion to the flow, the feeder is electronically paced by a six-inch water meter. Every time 20 gallons pass the meter, a dose of phosphate is added. This dose gives an average concentration of 2 mg/L. The chemical is mixed by turbulence created by elbows in the system. The solution is stored in a 30-gallon plastic drum which is refilled every 3 to 6 days depending on the water use. The use of a plastic drum allows a visual check on the level of remaining solution.

GM Profits From Water Conservation

More than 70 billion gallons of water per year are used by various General Motors plants in the United States and Canada. In order to conserve and control this consumption, the company instituted a program of study and conservation, some years back, which now is beginning to pay off in water savings and reduced costs.

At one plant, a saving of $5,000 per month in water bills was realized by simply changing the size of a nozzle. At another plant, one million gallons per day reduction in water requirements, from an overtaxed municipal system, was achieved by installing automatic water controls in place of manual in one phase of its operations. A third plant, by making a simple change in its process operations, made a significant reduction of its waste discharge.

The four-phase water conservation program consisted of an inspection of plant utilities, instruction of personnel on the need for and the benefits of water conservation, installation of safeguards against leaks and faulty controls, and a careful study of the best methods for designing future facilities with water conservation as a major goal.

Miller Received New Appointment

Wallace T. Miller, research engineer for the Cast Iron Pipe Research Association, has been appointed assistant managing director of the association, which includes the country's leading manufacturers of pipe used in water and gas distribution systems.

As assistant to Thomas F. Wolfe, CIPRA managing director, Miller has been active in supervising the association's current nationwide campaign to arouse and organize public support for improved municipal water treatment and distribution facilities.

Miller joined the association in 1954 after having served as the general manager of the Rochester division of the New York Water Service Corporation. Previously, he had been superintendent of the water department of Ossining, N. Y.

While chairman of the New York section of the American Water Works Association, he received the Fuller award for his activities in promoting the standards of water utility management.

Water Works Men Retire at Fort Knox

At Fort Knox, Kentucky, five civilian employees of the water works plant, having a combined service of 130 years, retired. They were guests at a banquet given by fellow employees and friends.

Retiring are: Mr. C. H. Miller; Mr. Jerome Cheatham; Mr. Emanuel Miller; Mr. Claude McPherson; and Mr. Hardin Boyle.

These men have seen the growth of the Fort Knox plant in supplying water from 100,000 to 10,000,000 gallons a day. The plant was the first in Kentucky to use activated silica for mud removal and softening, and the first in the state to use pulverized lime for water softening.

Certain Species predominate in the Fauna and Flora which establish . . .

Aquatic Life in a New Stream

by RUTH PATRICK, Dept. of Limnology,
Phila. Academy of Natural Sciences.

EDITOR'S NOTE: This article reports on six-months observations into the pattern of invasion and establisment of aquatic life in a new stream bed.

Organisms with the shorter life span were the quickest to establish natural and normal populations. Bacteria became established before algae. The invasion of macroscopic forms was irregular and sporatic. Only the snail seemed to be well established. Insect larvae of the type capable of filtering their food from the water were first to invade and become established in the new stream.

The stream bed itself was slow in developing into a habitat for aquatic invertebrates. Total organic matter in the stream bed and nitrogen content increased more rapidly in the mud of the slack waters than that forming the bed in fast water.

■ THE FAUNA AND FLORA of natural and polluted rivers have been the object of many studies both in this country and in Europe. However, no one seems to have studied the pattern of invasions and establishment of aquatic life into a new river area. Likewise the changes occurring in the river bed soil following its exposure to water has not been reported. Certainly, a new river bed must undergo changes to become a suitable habitat for worms and aquatic insects. The objective of this study was to observe these changes as they occurred.

The importance of this type of study is evident, since most of our knowledge of reforestation and reclamation of waste land is based upon a knowledge of plant succession on land. Such studies as these yield basic knowledge which should be useful in the reclamation of rivers which have been harmed.

New Stream Site Selection

In order to study the natural succession of invasion and establishment of the fauna and flora in a new area, a natural parent stream was required. A parent stream must have a water chemistry typical of the general region if conclusions are to be applied to a large area. A stream relatively free of pollution was desired, although it is almost impossible to find an area free from any pollution in the vicinity of Philadelphia. The factors controlling the choice of a parent stream were flow, nutrient level and water chemistry. A stream of eutrophic type was preferable to an oligotrophic one, or in other words, it is easier to be sure whether or not a species is established when the population of that species is relatively large rather than very small.

It was preferable to locate an experimental stream relatively near the Academy of Natural Sciences so that the area could be visited frequently and samples delivered quickly to the laboratory for study.

After considerable search Ridley Creek on the estate of Mr. and Mrs. Samuel B. Eckert was chosen. The area is a short distance below the juncture of two branches of Ridley Creek.

The chemistry of Ridley Creek waters is given in Table 1. The fairly large amount of magnesium in relation to the amount of calcium present is probably due to the prevalence of serpentine in the general Philadelphia area. However, the ratio of calcium to magnesium is more similar to the average for the area than several others examined. Indeed, when volume of flow, freedom from pollution, and chemical characteristics of the water are considered, the headwaters of Ridley Creek were the most desirable available for study near Philadelphia.

Table 1
Chemical Analysis
Ridley Creek
(mg/L)

Alkalinity	25.8
Total Hardness	44.0
Calcium	21.0
Chloride	8.0
Dissolved oxygen	10.0
Iron	0.071
Nitrogen as ammonia	0.046
Nitrogen as nitrite	0.004
Nitrogen as nitrate	0.535
Phosphate	0.018
pH	7.2
Silica	6.0
Sulphate	None detected
B.O.D.	1.4
Temperature	10.5°C

New Stream Construction

A bulldozer and back hoe were used to construct the new stream. The gradient of the stream was constructed to provide various types of flow and bed conditions. To simulate natural areas being imitated, the curvature of the stream was built to provide cutting and shoaling areas. The bed was constructed to provide back water, pool riffle and tail race of riffle. The beds of the pool and back water were mainly mud, the riffle was large stones and the tail race was fine stones and gravel. The stones for the stream were secured from the subsoil. These stones were typical of the area but free from eggs of animals and spores of algae. Some gravel was brought in. Care was taken in selecting gravel to match that of the area. The more important rocks and gravel composing the bed were Baltimore gneiss and Jasper. Quartz, hornblend gneiss, and brolite schist, serpentine, feldspar, limonite, and talc schist were also present.

Dikes around the stream were made in order to prevent abnormal washing during times of flood. The water from the parent stream was fed to the experimental stream through an open channel. A valve was provided to regulate the flow in the experimental stream. Usually the maintained flow varied between less than 0.88 to 7.3 ft/sec depending on the location of the habitat. The length of the experimental part of the stream was 88 ft. The breadth was 5 to 10 ft.

Methods of Study

The new area was completed and the study started on August 1, 1958. At this time no macroscopic organisms were visible in the area. For two weeks the stream was visited each day and observations recorded. Subsequently it was visited each week. Scrapings of the rocks for bacteriological and fungal studies and soil samples were obtained each week. Thorough collections of the aquatic life present were made on the first week of August, September, October, November, December, and February. These collections were supplemented with weekly observations. All organisms were identified to species.

The methods used for culturing the bacteria, actinomycetes and fungi from the water and soil were according to procedures developed by Dr. R. L. Starkey of Rutgers University. The methods for determining porosity and size particles were those set forth by C. E. Millar and L. M. Turk in *Fundamentals of Soil Science*. The total nitrogen was determined by methods described by M. L. Jackson (*Soil Chemical Analysis*, Prentice-Hall, Inc., 1958). The total organic matter was determined by chromate digestion following in general the methods set forth by *Standard Methods for the Examination of Water, Sewage and Industrial Wastes*, 10th edition.

Table 2
Species in Groups of Organisms
Number in New Stream and Ridley Creek as of February 5, 1959

Organisms	New Stream	Ridley Creek
Algae		
Diatoms	Normal ?	Average number of species in natural streams of Eastern Seaboard—86
Green Algae	Normal ?	
Blue-green Algae	Normal ?	
Protozoa	Normal	43 species
Invertebrates		
Bryozoa	———	1 species
Sponge	———	1 species
Sphaerid clams	———	1 species
Unionid clams	———	1 species
Physa	1 species	1 species
Ferrissia	———	1 species
Planorbid snails	———	1 species
Crayfish	———	1 species
Worms	A few in mud (10)	Well established (40)
Insects		
Damsel and dragonflies	———	2 species
Mayflies	3 species established 4 species not established	6 species
Stoneflies	2 species established	2 species
Beetles	2 species not established	4 species
Caddisflies	3 species established	11 species
Craneflies	1 species established	2 species
Blackflies	1 species established 2 species not established	3 species
Dobson flies, etc.	———	2 species
Fish	10-none established	20-30 species

Establishment of Aquatic Life

The scrapings from the rocks on August 5 indicated that the bacterial counts on rocks from the new stream were higher than those from rocks in the parent stream. Likewise the fungal flora (mostly composed of fungi commonly found in the soil) was better developed.

No algae were found on the rocks

Table 3
Mechanical Structure of Top Inch New Stream Bed Soil
(Per Cent having Particle Size)

	> 2.00 mm	> 0.84 mm	> 0.42 mm	> 0.25 mm	> 0.177 mm	> 0.149 mm	> 0.105 mm	< 0.105 mm
July, 1958	0.72	1.79	8.45	22.12	47.86	15.37	1.73	1.94
September, 1958								
Slack water	0.29	1.42	11.0	23.29	38.89	19.12	3.86	2.13
Below riffle	13.09	2.74	10.65	21.58	21.33	18.19	7.84	4.59
February, 1959								
Slack water	0.28	0.92	4.8	15.03	21.68	33.21	17.15	6.93
Below riffle	6.84	8.9	15.5	22.54	21.03	17.38	4.93	3.0

Table 4
Porosity of New Stream Soil

(Per Cent)

July, 1958	
Raw subsoil	44.97
September, 1958	
Slack water	41.4
Below riffle	38.7
February, 1959	
Slack water	43.9
Below riffle	38.4

or in the back water except for a few diatoms growing attached to roots extending into the stream.

The black fly, *Simulid vittatum* (Zett) was the first macroscopic animal to become established. Most of the rocks in the riffle proper had a few specimens present. The invading forms were very small larvae, probably the result of a recent hatch in the parent stream. This species usually has three broods a year—April or early spring, July or mid-summer, and October or mid-autumn. It is well known that the black fly larvae filter their food from the water which flows over them and are not dependent on the substrate.

Also present were a few small caddisfly larvae. Four were found on ten of the rocks carefully examined. None of these were forming cases, and they did not appear to be established. These organisms also filter their food from the flowing water. Three specimens of baetis mayfly larvae were found but did not appear to be established. They were more mature than the larvae of the black flies and the caddisflies. They in contrast to the other species feed on the substrate.

On August 6, a little green algae and a few diatoms were starting to grow on the rocks in the riffle.

The first definite algae flora appeared on August 12. It was mostly composed of diatoms, particularly *Melesira varians* Ag. It was very heavy on the mud forming the bed of the back water. An examination of the parent stream indicated that a similar heavy growth did not exist. It was therefore concluded that the heavy growth was due to the leaching of nutrients from the new soil cut. Such stimulation of diatom growth by drainage from the soil or by the addition of soil extract is well known in the literature. Intermingled in the *Melosira* filaments were red larvae of chironomids. These larvae are known to feed on algae.

Some of the rocks forming the riffle were fairly well covered with diatoms, but they were not nearly as abundant as in the slack waters. The insect fauna was similar in composition to that found on August 5. The populations of Simulids were much larger. For example, 21 specimens were found in an area of 15 square inches on a small rock. A few chironomid larvae were present on the rocks. An examination of the parent stream showed that although the black fly larvae were well established the population per rock was not nearly so large. In the parent stream there were many more different species per rock than in the new stream.

By September 4, the various luxuriant growths of diatoms had disappeared from the slack water and pool. It was not present on the mud and gravel in the fast water below the riffle. The insect fauna was augmented by the presence of *Stenonema bipunctatum*. It was difficult to determine if this species was really established in the stream because it was represented by only a relatively few small specimens.

Table 5
Total Nitrogen and Organics
Top Inch of Soil
Composing New Stream Bed
(Per Cent)

	Total Nitrogen	Organic matter
July, 1958	0.036	0.59
September, 1958		
Slack water	0.06	1.01
Below riffle	0.04	0.70
February, 1959		
Slack water	0.20	2.17
Below riffle	0.05	0.84

The lower invertebrates were absent except for one crayfish. This evidently had been brought in by the flow of water and was caught in the pool behind the riffle.

The fauna and flora continued about the same until the end of September. An accident resulting in pollution from an upstream farm resulted in the elimination of the insect fauna except for a few simulid larvae which evidently were produced by a hatch occurring a short time after the accident. Also a few chironomids survived. This condition was found in the parent stream below the source of pollution as well as in the new stream. The algae growth became very luxuriant as a result of the addition of a considerable organic material. The blue-green algae *Oscillatoria limosa* (Roth) Ag. and the green algae, *Stigeoclonium amoenum* Kg. became very abundant.

Six weeks elapsed before definite signs of recovery in the insect fauna took place. A hatch of stoneflies in the first half of November resulted in a large population of very small stoneflies, *Toeniopteryx niralis* (Fitch) appearing in both the parent stream and the new stream. During the following weeks they grew at a normal rate and showed no adverse effect from the pollution which entered the stream late in September. Smaller populations of *Strophopteryx fasciata* (Burm.) also appeared. As of November 18 the mayflies and caddisflies had not reappeared in the new stream.

During the following weeks the stream continued to improve. Table 2 shows a comparison of the fauna and flora which had invaded and for a time became established in the new stream during the first six months, with that of an upstream portion of the right branch which had not been affected by the accidental pollution which occurred late in September. As stated earlier this pollution only adversely affected the insects.

An examination of this table shows that the protozoa and algae which reproduce rapidly by asexual reproduction quickly established natural population in the new stream. The protozoan fauna was in normal condition in about ten days after the stream was established. This was also true for the algae and bacteria. It is interesting that these groups which

Table 6
Species of Algae
Number in Bed of New Stream*

	July, 1958	Sept., 1958	Dec., 1958	Jan., 1959
Slack water				
Top 1 inch	1	6	3	9
Middle 3 inches	2	—	—	2
Bottom 6 inches	—	—	—	—
Below riffle				
Top 1 inch		—	2	11
Middle 3 inches		—	—	—
Bottom 6 inches		—	—	1 (?)

* 30 or more specimens seen, or in majority of collections, 4 samples from each level of each locality examined.

Table 7
Bacteria and Fungi
New Stream Backwater Soil
Absolute Number

Date	Bacteria	Fungi
Top		
8/ 5/58	41,200.0	8,800.0
9/ 5/58	75,080.0	8,200.0
10/ 9/58	1,167,200.0	6,960.0
11/19/58	17,120.0	4,160.0
1/27/59	22,050,000.0	34,000.0
Middle		
8/ 5/58	54,500.0	6,000.0
9/ 5/58	640.0	360.0
10/ 9/58	134,000.0	1,400.0
10/19/58	11,920.0	640.0
1/27/59	180,000.0	780.0
Bottom		
8/ 5/58	2,660.0	2,000.0
9/ 5/58	6,040.0	520.0
10/ 9/58	81,200.0	760.0
11/19/58	7,520.0	1,720.0
1/27/59	28,000.0	540.0

are most important in forming the base of the food chain should be the first to become established.

The lower invertebrates during the six-month period had not become established in the new stream except for the snail, *Physa heterostropha* (Say) and a small population of worms which are detritus feeders. They were found among the leaves and mud which had been deposited in the slack water. An examination of the parent stream yielded the same species as shown in Table 2 which were taken from the right branch. This lack of establishment in the new stream indicates that invasion into a new area must be correlated with certain stages in the life history of the organism and/or certain environmental conditions. Further studies will clarify this point. The theory sometimes advanced that organisms randomly break loose from upstream habitats and drift downstream and become reestablished does not seem to be the usual pattern of invasion.

The insect fauna is spotty in its pattern and rate of establishment. The insect larvae which filter their food from the water were the first to become established. However, the full compliment of species found in Ridley Creek were not found in the new stream. Of the black fly larvae the one which was established was *Simulid vittatum* which has three broods a year. The stoneflies were the only group which had as many species established in the new stream as in the parent stream. These flies have a life cycle in the stream which extended from about the middle of November to about the middle of March. They were first noted as very small larvae, and appeared at the same time in the parent and new stream. As seen from Table 2, certain species of most of the main groups of insects have not become established. Two groups are not represented in the new stream.

The fish moved in and out but did not seem to be established.

Development of the Stream Bed

Although samples of soil were taken for analyses seven times during the six-month period, the data presented for comparison are those from the soil before it was exposed to the passage of water and the condition which existed in these muds after six months. Each result is the mean of the results from five cores. Table 3 presents the data on the mechanical structure of the top inch of soil in each core. In the slack water there was an increase in soil particles retained by the 0.149 mm screen in February when compared with July. Below the riffle this change was not evident. The porosity of the soil decreased slightly (Table 4).

The organic matter increased in the soil after exposure to water. This was much greater in the slack water than in the fast water below the riffle, Table 5. This was shown by both the total nitrogen and organic matter analyses. This would indicate that the water of the slack water might be somewhat richer in nitrogen and other components of organic matter than the water below the river. Perhaps this is a contributing factor to the increase in plankton behind dams or in areas where the flow is greatly reduced.

No typical Protozoan fauna developed in these soils. As seen from Table 6, it was the top inch of mud in the slack water and below the riffle which develop an algal flora.

The bacteria in the soil was greater in the top inch than in the soil taken at three inches and at six inches, Table 7. This was also true for the fungi. There was a general trend toward an increase in the bacteria in the top inch during the six-month period. This trend was not so evident in the fungi. The three-inch depth and the six-inch depth did not show this trend. The numbers of colonies per gram in the six-inch depth were less than at the surface. This was also true for the fungi at the three-inch depth. The numbers of bacteria and fungi per gram are similar to those reported by Waksman (*Soil Microbiology* by S. A. Waksman, 1952).

Table 8
Fungi
New Stream Soil Samples

	Most Common	Common	Least Common
Class Fungi Imperfecti			
Order Moniliales			
Family Moniliacea			
Cephalosporium	x		
Trichoderma	x		
Gliocladium	x		
Spicaria	x		
Verticillium	x		
Family Dematiaceae			
Cladosporium	x		
Trichosporium	x		
Hormodendrum	x		
Alternaria	x		
Stemphylium	x		
Stachybotrys	x		
Papularia	x		
Pullularia	x		
Torula	x		
Class Ascomycetes			
Order Plectascales			
Family Aspergillaceae			
Aspergillus		x	
Penicillium		x	
Class Phycomycetes			
Order Saprolegniales			
Family Saprolegniaceae			
Achlya			x
Dichtyucus			x
Order Leptomitales			
Family Leptomitaceae			
Leptomitus			x
Order Mucorales			
Family Mucoraceae			
Mucor			x
Rhizopus			x
Zygorhynchus			x

The relative abundance of the various genera found in the soil are given in decreasing order of abundance, Table 8. It will be seen that the genera of the Imperfecti which are often found in soil are the most common.

From these studies it is evident that the algae, bacteria and fungi are most common in the inch of soil just below the surface. They decrease in number as the depth of the soil increases. It will be interesting to determine if this gradient is as distinct as the stream becomes older.

Conclusions

At the end of six months a con-

siderable amount of change occurred in the stream. Those organisms with the shortest life span were the quickest to develop natural or normal populations. The bacteria became well established on the rocks before the algae. The heaviest algae growth occurred first on the surface of the soil in the slack water. Evidence indicates that the leaching of nutrients from the soil may have been largely responsible for this heavy growth.

The invasion of the macroscopic forms was very irregular and sproadic. Of the lower invertebrates only the snail, *Physa heterostropha*, seems to be well established. Most of the insects seem to invade the areas as very small larvae. Those larvae which filter their food from the water were the first to be established.

The bed of the river seems to develop rather slowly as a habitat for aquatic invertebrates. The increase in nitrogen and total organic matter seems to increase more rapidly in the mud of the slack waters than in the mud forming the bed in fast water.

Acknowledgment

This study was made possible through the generosity of Mr. and Mrs. Samuel B. Eckert who made their land available for constructing a small stream and the Manufacturing Chemists' Assoc. who supplied the money for the study.

Our appreciation to Dr. G. Evelyn Hutchinson, Dr. R. L. Starkey, and Dr. H. R. Roberts for their helpful advice and criticisms during the course of this work.

This program of work has been planned and supervised by the author who also participated in the collecting of aquatic organisms and some of the identification of algae. Mr. Radclyffe B. Roberts visited the stream weekly and carried out the general maintenance of this project. He also assisted Dr. Bubieniec who had charge of the chemical, bacteriological, fungal analyses, and the identification of the fungi. The soil analyses were made by Arthur Scheier and Virginia S. Irving.

The identification of the organisms were made by the following: Protozoa—John Cairns, Jr., Mary Gojdics; Invertebrates—John B. Bates; Insects—Selwyn S. Roback; Fish—James E. Bohlke; Algae—George Claus, Ruth Patrick.

Solar Radiation Treats Sewage Lagoons

According to Governor Lawrence of Pennsylvania, The Pennsylvania State Sanitary Water Board made a major step forward in community health planning by approving the use of the lagoon method of using "solar radiation" for treating sewage in stabilization ponds.

The board's action came after inspection of an experimental lagoon in Hampton Township, Allegheny County, the state's first sewage stabilization pond, which had been in operation for eight months under an experimental permit.

Water Management Needed

Although the nation as a whole has an adequate, if not an abundant, supply of water, many areas and communities frequently are faced with a drastic water shortage. Even though a particular state may, in its overall picture, have an adequate water supply, frequently many of its separate communities experience periods of drought or some other kind of water shortage. The cause of water shortages, then, which are always experienced in a particular area or community, is in the use or misuse of the generally adequate available water.

This significant observation was made in a recent address given by R. L. Nace, Associate Chief, Water Resources Division, Geological Survey, Department of the Interior before the Texas Water Conservation Association, in Dallas.

Mr. Nace said that the water problem called for intelligent, unselfish management of water for all purposes. "It seems essential," he continued, "that water planners and managers, all the people who make decisions, take a fresh look at large-scale developments and long-term commitments of water, and make sure that they recognize the real long-range problem."

The role of the Geological Survey, according to Mr. Nace, is to provide the managers and planners of water control and supply programs with the scientific data necessary for their considerations and subsequent decisions.

The men making these decisions, he said, "have a greater responsibility than to plan series of projects for construction during the next 20 to 30 years. The more important responsibility is the kind of a situation and problems that will be handed over to the manager who takes over 30 years from now.

"Unless development projects and commitments of water are closely coordinated and based on sound estimates of the kind of civilization for which water will be needed far in the future, the water manager of the future will have an extremely difficult task. For example, water might be committed so thoroughly to a given area or use that the commitment could be changed only with great difficulty."

Detergent Study

Recent Studies at the University of California on the engineering aspects of ABS removal by surface stripping have demonstrated the relationship of air supply and depth of sewage in regard to achieving maximum efficiency. Experiments have shown that for a given rate of application of air there is an optimal surface area to volume ratio. A straight-line relationship indicates that the ratio is reduced with increased rate of air application. It has also been determined that for a given level of ABS removal, the amount of air required per unit volume of sewage is a constant.

At present, a surface stripping tank of considerable size is under construction. Its primary purpose will be to determine the feasibility of destruction of large quantities of foam by burning with digester gas after the foam has been channeled into a separate chamber. Attempts to destroy foam as it is being formed by substitution of methane for air with continuous surface burning were not successful due to the inability of methane to remove ABS adequately from the sewage. However, future work involving the concurrent use of both air and methane might overcome this obstacle and prove to be the most satisfactory method of foam destruction.

THRIFT is the ability to see that things are just as expensive on pay-day as when one's purse is almost empty.

A critical problem in stream pollution comes from . . .

Thermal Discharges

by RONALD H. LABERGE,
Research Fellow, School of Pub. Health, Univ. of Mich.

RESUME: The intent of this paper is to explain the effects of temperature on a stream. Thermal loadings to streams are rapidly becoming a critical problem in regard to maintaining a healthy lotic environment. Fish and acquatic life are discussed with reference to: the optimum, tolerable and critical temperature levels; chemical toxicity and oxygen requirements. The effects of temperature self-purification characteristics of a stream are shown by means of a hypothetical river situation. The relation of oxygen, deoxygenation and reaeration are quantitatively developed. A method is presented for computing the allowable thermal loading to meet required minimum dissolved oxygen levels.

■ A STREAM'S ENVIRONMENT changes with the course of its development. The gushing waters of the mountain brook form placid lowland streams then rivers which in turn contribute to the tidal rivers which eventually discharge to the ocean. Each displays an entity peculiar only to itself. A stream's characteristics are dynamic: governed by environment, ever changing, never static and forever in a state of non-equilibrium.

A stream's environment is a function of many contributing factors. To mention but a few: The physiography of its drainage area—its ground cover, soil type and land uses; the seasonal pattern of air and water temperature; the quantity and patterns of precipitation; the seasonal pattern of runoff and flood frequency. It is not implied that a stream's environment is governed only by "natural" factors. Pollution, through domestic and industrial discharge, alters the streams "natural" environment and in doing so, alters the aquatic communities contained therein.

Of the more important pollutional changes in the biological balance of a stream, the effect of temperature has not received the attention nor study it demands. Stream temperatures through heated domestic and industrial effluents have steadily increased in some areas until they have become almost equal in status to organic pollution.

Existing thermal loadings discharged to streams are at present only of local concern. To mention a few: The Mahoning River and Miami River in Ohio; the Tittabawassee River in Michigan, and the Fox River in Illinois. The thermal loadings which can be expected in the coming years, however, may well develop into a national problem.

Thermal pollution today may be in the same stage of development as organic pollution was in the 1920's. Future increases in power production will cause proportional increases in heated effluents to streams. Figure 1 shows the actual peak kw production from 1948 to 1957 and the predicted production to the year 1975. In 1960, the estimated peak production will be about 210 billion kw which triples the peak production of 62 million in 1950. The 1975 peak production is estimated at double the 1960 value. Although, the predicted increase seems unbelievable, it should be noted that experts have consistently revised their "guestimates" upwards. The data portrayed in Figure 1 are not at all unreasonable. It can be safely assumed that a fair share of the expected thermal discharges from atomic power plants will be distributed throughout the country's river system, adding measurably to future thermal loads.

It is seen that pollution of our streams and rivers through temperature increases is a very real and pressing problem. Quantitative formulations for the temperature effects on the biological balance are, therefore, very much in need.

Temperature and Aquatic Life

In general, the temperature of streams of moderate depth will not be much below the monthly mean air temperature. In the critical summer months of July and August, the water will be within 3° C above or below the monthly mean air temperature during July and from 2-5° C above the monthly mean air temperature in August. The higher stream temperatures usually occur after a succession of warm days and nights with the peak temperatures occurring in the mid-afternoon.

Temperature zones in which fish can live in comfort is generally limited to a range of about 15° F[2]. How-

ever, the tolerance to a specific temperature level is not necessarily correlated with the geographical location of a fish population but rather, to the species itself[3]. Although fish can live in comfort throughout a range of 15° F, a sudden temperature change of a lesser magnitude could be lethal. For example, a sudden rise of more than 2° C may be harmful to the American Sunfish[4]. A slight rise of 2-3° C is sometimes sufficient to eliminate trout or to render the stream less favorable and undesirable for them[5]. Few trout, even the most tolerant species, can survive temperatures above 82-83° F even for short periods[6]. Should sublethal temperatures be maintained for protracted periods, some fish populations will be reduced and conditions made more favorable for the more heat tolerant species. Temperatures exceeding the lethal limit for only short periods will reap disastrous effects.

Fish have mechanisms whereby they may become acclimated to increased temperatures. However, regardless of the period of acclimization the temperature at which the most hardy of species cannot survive is about 104° F[3]. Other inhibiting agents may also become a factor. For example, no apparent harmful effects to bass and other fish were observed at a temperature of 96° F in the T.V.A. reservoir of northern Alabama[6]. This same worker, however, found that in the northern part of the country bass have been killed by a water temperature of 94° F.

It is seen therefore, that temperature does not act as a separate agent. That is, there are associated "secondary" phenomena which inhibit fish life. Increased stream temperatures multiply the toxicity of many poisonous materials. This is presumably a synergistic action. For example, a 10° C rise doubles the potassium cyanide toxicity to fish[7]. Toxicity to o-xylene was trebled by an 8° C rise[8]. Since the temperature effect on toxicity varies with each substance and with concentrations of any specific material, no formulation of a hard and quick rule may be made in determining this temperature effect.

Increases in stream temperature through heated effluents will usually be discharged in or near domestic or industrial waste effluents. The synergistic relationship between temperature and toxicity is therefore a relatively common occurrence. In polluted waters, fish kills caused by a small rise in stream temperature have occurred. This same rise in temperature may have been relatively harmless in an unpolluted stream where toxic substances were absent. The reverse of this is also true. That is, toxic substances may be of such a concentration as to be unable to cause fish kills without a corresponding higher temperature increasing its toxicity.

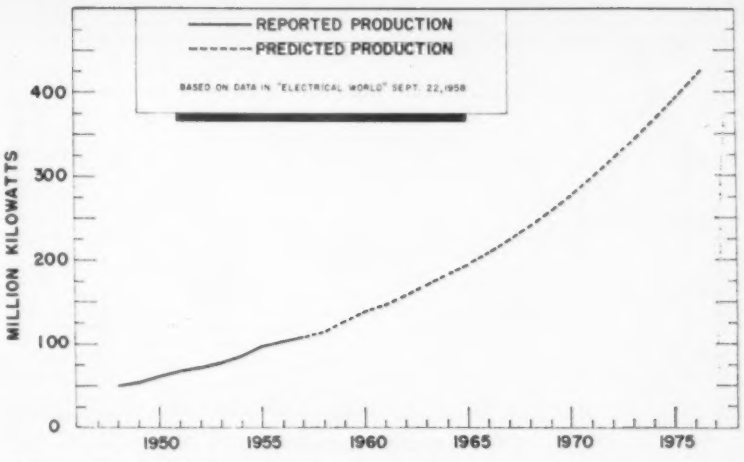


FIG. 1. U.S. PEAK Power Production.

As stream temperatures rise the ability of a stream to hold dissolved oxygen decreases. At 20° C, 9.17 mg/L can be dissolved while at 30° C only 7.63 can be dissolved.

As the temperature is increased the metabolic rate and corresponding oxygen requirements of fish and other aquatic organisms are increased. According to van t'Hoff's law the rate at which respiration and other oxidation processes proceed is approximately doubled or tripled for every increase of 10° C. For example, it has been shown that for short periods of exposure, the minimum lethal concentration of dissolved oxygen for Yellow Perch was 0.77 mg/L at 11.1° C and 1.34 mg/L at 21.1° C[9].

At high temperatures, fish need more oxygen when the stream has less oxygen available for utilization. In a temperature range from 0-4° C many fresh water fish can tolerate a D.O. content as low as 1-2 mg/L. However, when the temperature is increased to a range of 15-20° C 3.0 mg/L is generally lethal but 5 mg/L non-lethal.

The Aquatic Life Advisory Committee of the Ohio River Valley Water Sanitation Commission has formulated even more stringent dissolved oxygen criteria[10]. They state that for warm water fish not less than 5 mg/L of dissolved oxygen should be maintained during at least 16 hours of any 24 hour period. The dissolved oxygen content may be less than 5 mg/L for a period not to exceed 3 hours within any 24 hour period, but at no time should be less than 3 mg/L. For coarse fish 5 mg/L is recommended, but for 8 hours out of a 24 hour period may go down to 2 mg/L.

As the dissolved oxygen content is reduced the more active aquatic forms are likewise reduced. When the oxygen content declines to a few tenths, those forms requiring dissolved oxygen for their life processes are suddenly terminated. At these low levels of oxygen content, the anerobic forms predominate, that is, organisms which can respirate in the absence of oxygen.

In relation to a stream's capacity to purify itself, an oxygen demand is made upon the stream's oxygen supply by organic waste materials. Should the oxygen level be maintained within the bounds of aerobic decomposition the stream will purify itself without any asthetic disturbances. However, should the oxygen supply be entirely utilized, anerobic decomposition will occur and the stream will become putrescent with subsequent production of offensive odors and unsightly scum.

A stream is a complex community of interdependent aquatic organisms. Adverse effects, therefore, on any one segment of the population will in turn be reflected in the life patterns of the entire community. The balanced aquatic communities are composed of species which are best fitted to the local environmental conditions. Each

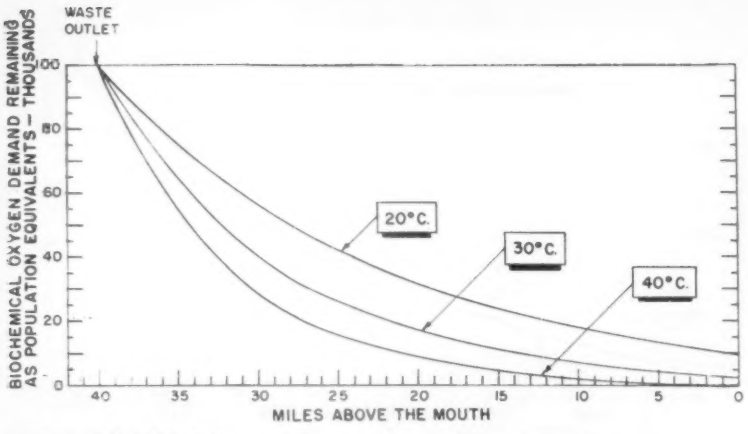


FIG. 2. RELATION Between Temperature and Deoxygenation.

of these species vary greatly as to temperature tolerance. For example, the algae group diatoms grow best at 15-25° C; green algae at 25-30° C, and Blue-green algae at 30-40° C[3]. However, unfavorable temperatures as opposed to lethal temperatures may cause a species to virtually disappear due to the fierce competition existing among the stream's population. This in turn, is an upset in the rate of food production for higher species.

Increased temperatures are not limited to only those effects already cited. Excessive growth of sewage fungi and of water weeds[11] may be the result of increased temperatures. High temperatures may induce spawning at unnatural times and should the temperature then drop, these organisms will be unprotected. The changes which would be associated with continued maintenance of high temperatures on the aquatic organisms are not at present established but presumed to be undesirable[6].

Temperatures and Oxygen Balance

The effects of temperature change on the oxygen balance of a stream are manifold. An attempt to combine these effects into one parameter would be folly. To fully understand the function which temperature plays, a simple river situation is used. The purpose is to illustrate through quantitative measures, the temperature effect on deoxygenation, upstream residual dissolved oxygen, and reaeration. The abnormalities of self-purification such as benthal oxygen demand from sludge deposits and biological adsorption are not discussed. The following analysis is based on the same temperature existing throughout the entire stretch of river. In the case of thermal effluents, the assumption of a constant temperature is not true (to be discussed later). The purpose of these computations is to show how a stream's self-purification characteristics react under different temperature conditions.

As stream temperatures increase, the rate at which the organic waste matter will be oxidized is increased proportionately. As expressed by Streeter and Phelps[12], ". . . the rate of the biochemical oxidation of organic matter is proportional to the remaining concentration of unoxidized substance measured in terms of oxidizability." Expressed as an equation,

$$\frac{L_t}{L} = 10^{-kt}$$

where:
L = ultimate biochemical oxygen demand (BOD ult.)
L_t = BOD at time t
t = time (usually days)
k = rate of biochemical oxidation

The value of k is a function of temperature. This relation being,

$$k_T = k_{20}\,\theta^{T-20}$$

θ = 1.047
T = temperature in °C

In the analysis of a particular river problem the value of k must be determined in the laboratory. The "normal" value of k, equal to 0.1 (time in days), has been used in the following computations.

Figure 2 illustrates the relationship between temperature and the deoxygenation profile. This results from an assumed effluent at the waste outlet of 100,000 Population Equivalents [1 Population Equivalent (P.E.) is taken as 0.24 16 BOD ult]. Referring to Figure 2, it is seen that as temperature increases there is less BOD remaining or, conversely, that more BOD has been satisfied at each station. For example, at Mile Point 24.0 there remains of the total 100,000 P.E. discharged to the stream, 40,000 P.E. at 20° C, 24,000 P.E. at 30° C, and 13,500 P.E. at 40° C. It is seen, therefore, that as temperature increases more of the BOD is satisfied thereby creating a greater uptake of the available oxygen resources of the stream in a shorter reach of river.

The above discussed one of the factors which take oxygen from a stream. What are those factors which supply oxygen? They are: 1) the residual oxygen content existing above the waste outlet, and 2) the oxygen available through reaeration.

Reaeration is affected by temperature in two distinct ways. Reaeration is a function of the oxygen deficit in the stream. The greater the difference between the saturation value and that actually present (the deficit) the greater the reaeration. Therefore,

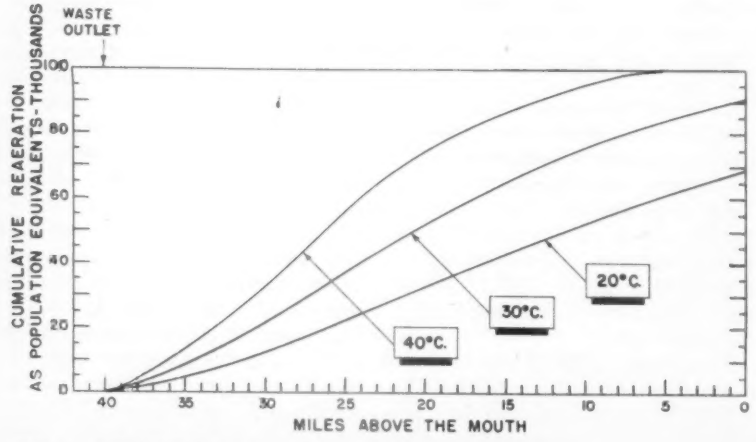


FIG. 3. RELATION Between Temperature and Reaeration.

since at higher temperatures more oxygen is demanded through deoxygenation in a short period, reaeration is increased proportionately.

Phelps' fundamental law of reaeration[13] is expressed as:

$$D_t = D_a \times .811 \left(e^{-k} + \frac{e^{-9k}}{9} + \frac{e^{-25k}}{25} + \ldots\right)$$

where:

D_a = initial dissolved oxygen saturation deficit

D_t = dissolved oxygen deficit after time t

$$k = \frac{^{2}at}{4L^{2}}$$

L = depth

a = diffusion coefficient

Professor Velz[14] has shown the diffusion coefficient to vary with temperature in accordance with the relation:

$$A_{T^\circ C} = A_{20^\circ C}\, 1.1^{(T^\circ C - 20^\circ C)}$$

Using the refined techniques developed by Professor Velz[14] for computing the self-purification characteristics of a stream, Figure 3 has been computed to quantitatively show the reaeration which is to be expected in the hypothetical river. The assumed conditions are: 1) a once in five year consecutive seven-day flow with a residual dissolved oxygen of 85 per cent of saturation, 2) a mean depth equal to 8 ft, 3) a mix internal of 24.5 min. The reaeration curve developed for 40° C increases more rapidly than for lower temperatures. To illustrate, at mile point 24.0, the total cumulative asset from reaeration for 40° C is 61,000 P.E., for 30° C it is 41,000 P.S., and for 20° C it is 24,000 P.E. As pointed out previously, this is to be expected due to increased oxygen deficit and increased diffusion coefficient.

The full impact of temperature on the oxygen balance of a stream is realized by fusing deoxygenation and reaeration as shown in Figure 4. The abscissa of Figure 4 is expressed in mg/L of dissolved oxygen rendering it more applicable for practical interpretation. It is evident that at lower temperatures the dissolved oxygen available from upstream is increased. The dissolved oxygen saturation values at 20, 30, and 40° C are 9.17, 7.63, and 6.6 mg/L respectively.

Having assumed a dissolved oxygen residual of 85 per cent of saturation, these values for 20, 30, and 40° C become 7.80, 6.48, and 5.61 mg/L respectively. The oxygen profile at higher temperatures, therefore, is inherently lower at the waste outlet. At higher temperatures and under the same organic waste load the oxygen level dips more rapidly and deeper than at lower temperatures. For example, the critical low dissolved oxygen for 40° C is 1.2 mg/L, for 30° C is 2.5 mg/L, and for 20° C is 3.65 mg/L. The effect of pollution is felt in a shorter reach of river at higher temperatures while at the lower temperatures the effect is felt for a much longer stretch of river. While lower temperatures cause the oxygen level to remain depressed for a longer period the oxygen profile does not dip to the devastatingly lower values of the higher temperatures.

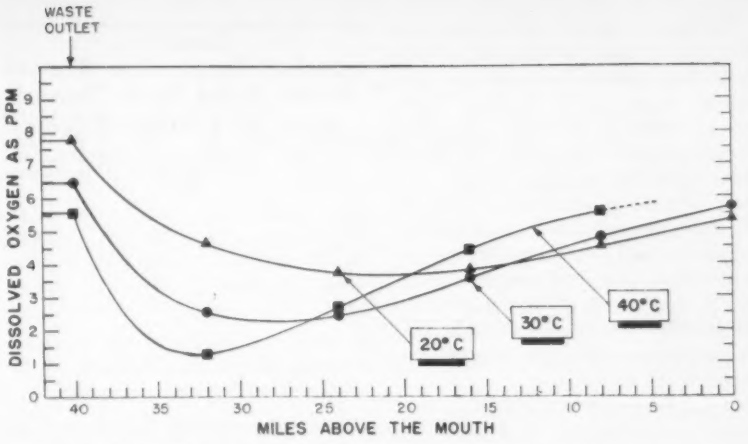


FIG. 4. RELATION Between Temperature and Oxygen Profile.

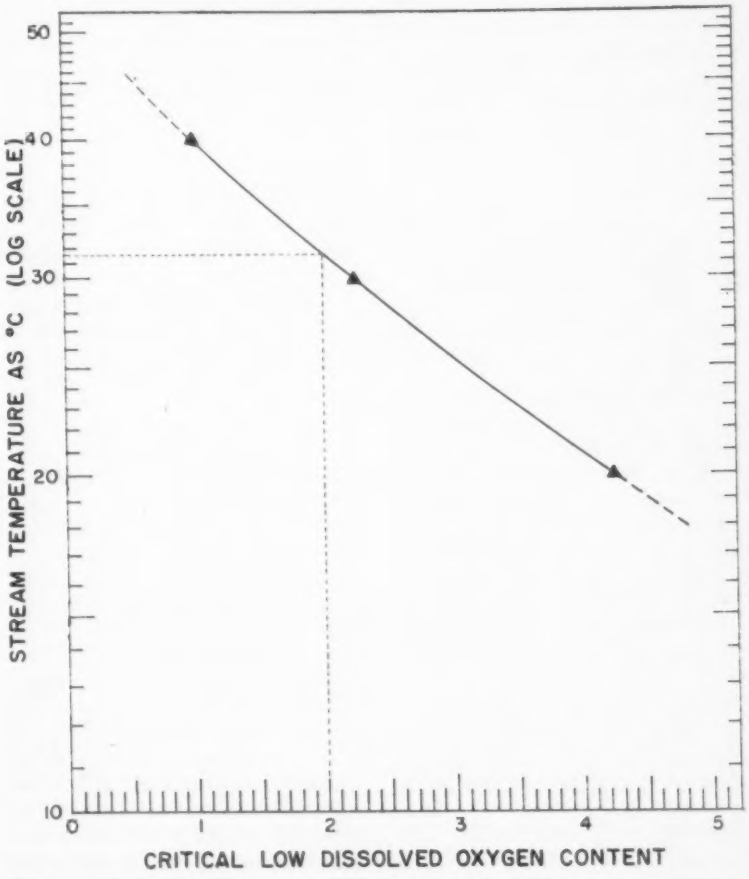


FIG. 5. RIVER Temperature and Critical Low D.O. at once in 5 yr. Low Flow of 500 cfs.

Having computed the critical low dissolved oxygen content for at least three temperature conditions, it is then possible to prepare a "control" chart for determining the maximum temperature which will produce the minimum allowable dissolved oxygen content. Figure 5 has been drawn to illustrate this relation. Assuming that the stream had been classified to allow a minimum dissolved oxygen content of 2.0 mg/L, it is evident that under the assumed pollution load and runoff, the maximum allowable temperature would be 31.5° C.

Again it should be emphasized that these computations represent the oxygen balance under uniform temperatures from the waste outlet to the mouth of the river. However, if these formulations are to be applied to a stream which receives a heated discharge, uniform temperatures throughout the length of river will not exist. A thermal load raises the temperature of the water at the outlet. As the water progresses downstream the temperature declines logarithmically. A rough formulation used for determining the temperature at any point downstream from an outlet, reported by LeBosquet [15], is:

$$F = Fa\ 10^{-0.0102\frac{KWD}{Q}}$$

where:

F = excess temperature in °F. (of water over air) at distance D
Fa = initial excess temperature in °F
W = average width of stream in feet
D = distance in miles
Q = flow in cu ft per second
K = heat exchange coefficient in BTU per Ft^2 per °F excess temperature per hour.

The heat exchange coefficient K may be expected to range from 3-16 Btu/ft^2/°F/hr depending on stream conditions. A deep sluggish river will have a lower heat exchange coefficient than a turbulent shallow stream. For example, on a section of the River Lea in England[16], parts of which are canalized and used for navigation, an average value of the heat exchange coefficient was found to be 2.25 cm/hr (K = 4.6 Btu/ft^2/°F/hr).

Thus, it is possible to more reasonably define the expected dissolved oxygen profiles by accounting for the decline in stream temperature as the water flows downstream. It should be noted, that the available stream flow materially affects the temperature rise at the waste outlet. For example, at a thermal loading of 3 billion Btu/hr and for the low flows of the river

Table I
Expected Temperature Rise At Waste Outlet For A Thermal Load Of 3 Billion BTU/hr.

Return Frequency	Consecutive 7-day Drought Flow cfs	Temperature Rise at Waste Outlet °C
Most Probable	660	11.2
Once in 5 Years	500	14.8
Once in 10 Years	420	17.7
Once in 20 Years	350	21.3

as shown in Table 1, the expected temperature rise in the stream at the waste outfall has been computed.

Having developed the temperature profile of a stream, it follows that a "control" chart similar to Figure 5 can be developed for various thermal loadings discharged to he river. After defining the relationship between thermal loading and critical low dissolved oxygen content for a specified design low flow, the extent to which the waste water should be cooled prior to discharge can easily be determined. This cooling, accomplished through the use of cooling ponds, spray ponds or cooling towers should, of course, enable the stream to provide the recommended oxygen levels as previously set forth.

Summary

Stream pollution through the discharge of heated waste effluents is rapidly becoming a critical national problem. The U. S. power production estimates indicate that the thermal discharges of the future will be many times the present level.

The effects of temperature on aquatic life are felt in many ways. A sudden rise in temperature, a prolonged sublethal temperature and a short period of lethal temperature reap disastrous results on a stream's aquatic life. Coupled with the direct effects of temperature are: 1) the synergistic action in the presence of toxic chemicals, and 2) the need for higher concentrations of oxygen to satisfy increased metabolic rates.

Thermal discharges are usually combined with, or in close proximity to, other waste effluents. The result is a more rapid exhaustion of the available oxygen resource of a stream at higher temperatures. It is possible to predict the effects of various thermal discharges on the oxygen profile by accounting for the logarithmic decrease in temperature as the water progresses downstream. The relation between thermal load and critical dissolved oxygen content can be developed to ascertain the extent to which thermal effluents should be cooled prior to being discharged to a stream.

Acknowledgment

The author wishes to express his gratitude to Professor C. J. Velz, Chairman, Department of Environmental Health, School of Public Health, University of Michigan, for his invaluable teaching and guidance in the author's study of the many problems involved in the field of stream pollution.

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A discussion of a very useful tool

Silica Sols in Water Treatment

by F. R. MAC GONAGLE
Philadelphia Quartz Co.
Philadelphia, Pa.

EDITOR'S NOTE: Activated silica is a valuable tool in the coagulation of water. Either as a coagulant aid or as the sole coagulant it has been very useful for removing color and other impurities from water. Mr. Mac Gonagle in this article reviews the applicability of this compound, methods of preparation and activation. He also discusses cost and dosages used in various applications.

■ IT IS AN accepted fact that various waters possess vastly different characteristics and no single set of rules can be laid down for their general treatment. There are, however, certain basic fundamentals dealing with all water treatment and these are worthy of consideration regardless of water characteristics the individual operator is dealing with in his own plant.

Basic Factors

Whenever foreign matter is present in water, it exists in three possible states: In suspensions, In colloidal form, or In solution. If the foreign matter is present in suspension has a particle size sufficiently large or if the suspended particles are heavier than water, preliminary settling may be used. In the case of materials lighter than water, such as oils, skimming operations may be employed. This is followed by coagulation. If the foreign matter in the water is in colloidal form, it may be coagulated at once.

If the foreign matter is present in solution form, there is the possibility of chemical treatment to convert it into an insoluble form following which it may be separated from the water by coagulation. When a coagulant such as alum or iron salts is used, it reacts in the water and to form a floc. The floc particles entrap or attract the impurities in the water and separate them from the water to be removed by subsequent mechanical means.

It is at this point that the use of silica sol shows its effect. When the coagulant reacts chemically with the alkalinity of the water and forms a floc, the silica sol attracts small particles of this floc together into larger sized complexes and makes the coagulation more complete. The silica sol, in fact, has the property of making the floc particles heavier and thus causes them to settle more quickly than they would if formed from the coagulant alone.

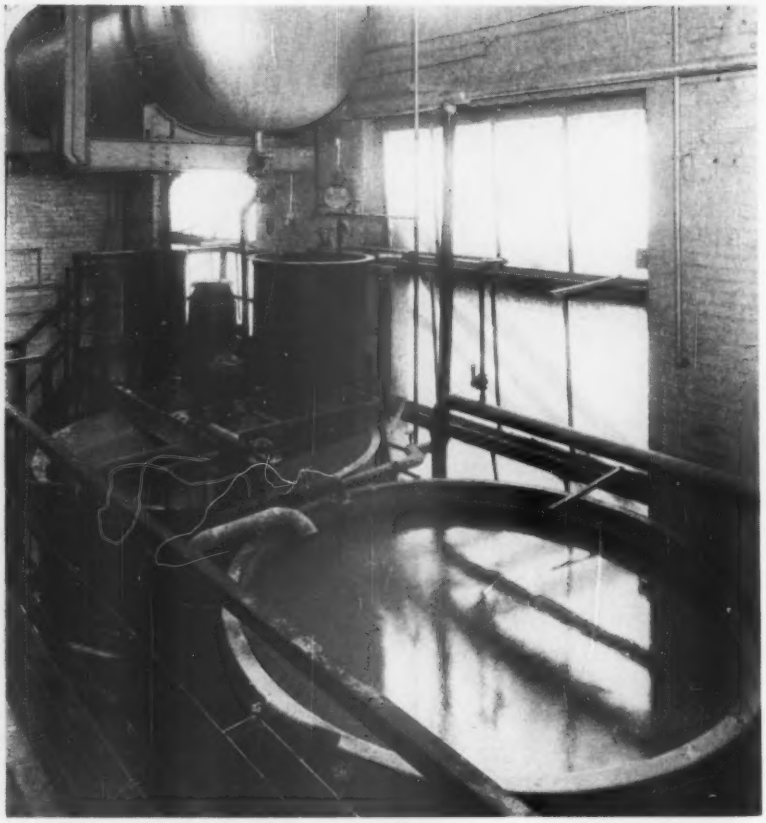
Previous remarks have applied to the use of silica sol as a coagulant aid in conjunction with some other coagulant. In lime softening reactions, its function operates somewhat differently. The calcium carbonate formed during a softening reaction is coagulated, usually by alum, and then removed from the water either by means of conventional settling basins, or by passing through one of the so-called up-flow units. It should be noted, in regard to this reaction, that the calcium carbonate is formed by reaction of the lime with the hardness of the water. The alum or sodium aluminate added to this system promotes the coagulation of the calcium carbonate. The silica sol when used in a softening reaction acts similarly to alumina as a coagulant itself. There are several instances where alum has been dispensed with altogether and the lime floc has been coagulated with silica sol alone.

In commenting on this reaction, Dr. A. P. Black, Research Professor of Chemistry, University of Florida, Gainesville, Florida, said, "While activated silica sols used in conjunction with another coagulant should properly be called a coagulant aid, the time has come to recognize that it may and often does itself act as a coagulant in the truest sense of the word."

The silica sol is not sold as such but is prepared by the user from sodium silicate mixed with a chemical which will react with the alkali of the silicate and liberate the silica in sol form. There are numerous types of sodium silicate on the market, but the type preferred, from the standpoint of economy and silica content for this work is a 41° Baume solution containing approximately 8.9 percent sodium oxide and 28.7 percent silica. Various manufacturers identify this particular sodium silicate by their own trade names.

Preparation

This "n" sodium silicate is first



SILICATE STORAGE TANK and mixing basin for continuous preparation of activated silica with sodium silicate.

diluted with water in order to prevent gelation when the reactant is added. Separately, the reactant is dissolved in water and this is added to the silicate solution under conditions of rapid agitation. A number of reacting chemicals can be used for this purpose. Among these are ammonium sulphate, alum, chlorine, sodium bi-carbonate, various mineral acids and acid salts. The choice of the reactant usually depends on the individual requirements and conditions. After this reaction takes place, the solution is allowed to age for a predetermined length of time and then the sol is diluted to prevent progress toward gelation. The sol is then ready for use. The above method is a description of the so-called "batch method" of preparing silica sol. It requires the preparation of batches periodically as the sol supply becomes exhausted. More recently, various manufacturers have developed ingenious pieces of equipment which accurately proportion the silicate, water of solution and dilution, and reactant into a common mixing chamber at a pre-determined concentration after which the sol, thus formed, passes through a retention chamber and on into the system without further dilution. This eliminates the necessity of making batches and assures continued accurate calibration of the various chemicals being combined to form the sol. The sol, thus made, is added to the coagulation system at a point which preliminary laboratory tests have indicated most advantageous for the operation.

Laboratory Preparation

Before activated silica sol is applied in a plant operation, the most favorable order of addition of the various chemicals and also the proper magnitude of addition, based on the water being treated, should be studied in the so-called laboratory jar tests. By simulating plant conditions of agitation and settling times available, the optimum conditions for the use of the chemicals can be ascertained. A rough guide to be followed as a starting point in such silica sol studies is as follows:

1. For most raw waters an average of 5 mg/l with a maximum of 20 mg/l and a minimum of 1 mg/l silica sol.
2. For industrial wastes from 5 to 25 mg/l silica sol although for certain highly concentrated wastes possibly a higher figure will be found necessary.

If the dosage is based on the current alum usage, the following ratios of silica sol to alum have been found generally applicable.

1. For low turbidities, low water temperatures, starts with 15 to 40 percent of the usual alum dosage as silica sol.
2. For higher turbidities for color removal, use 5 to 15 percent of the usual alum dosage of silica sol.

During such laboratory studies a decision as to the reactant to be used to neutralize the alkalinity of the sodium silicate should be reached. This decision will be made on the basis of economies, convenience of operation and purpose for which the water is used.

It might be pointed out that, among the number of possible reactants, ammonium sulphate has found favor in a number of instances. In the first place, it is possible to attain 100 percent neutralization with this reactant. The alkalinity of the silicate is tied up as sodium sulphate and both silica and ammonia are liberated. If it is desirable to obtain subsequent sterilization by the use of chloramines, this ammonia is available to combine with chlorine added to the water for the production of chloramines to carry the sterilization through the system. If, however, the water being treated is to be used in high pressure boilers, there is danger that the ammonia content in the water will attack the copper on the turbine blades, etc., so ammonium sulphate, in this instance, should be avoided.

Acids are attractive from the standpoint of economy, but they are difficult and dangerous to handle and there is a chance of forming gels unless careful control is exercised.

Sodium bicarbonate is being used in a number of installations, although in some territories its cost is relatively high.

Probably the greatest interest is currently directed to the use of chlo-

rine. When the chlorine gas is dissolved it forms hypochlorous and hydrochloric acids. The reaction of the hypochlorous acid with the silicate gives the same end results as the chlorine dissolved in water will produce as far as available sterilization is concerned. It can be readily recognized therefore that the chlorine used to react with the silicate can be substituted for chlorine which would be added to the water for strictly sterilization purposes and therefore represents an economy as far as chlorine being used as a reactant is concerned.

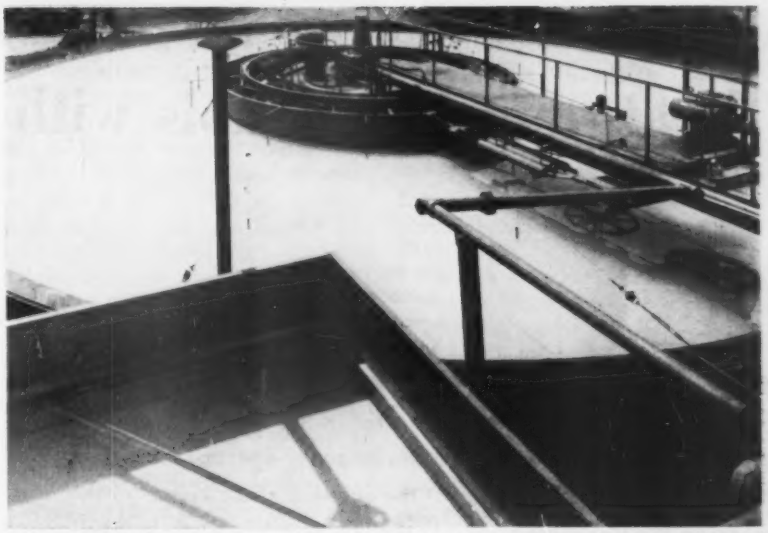
Application

Silica sol has proved to be effective in water treatment under a great many different conditions. Early work was done under conditions of relatively high turbidity and here it proved itself to be a valuable coagulant aid.

Later, in relatively clear highly colored waters, the silica sol again performed very satisfactorily. It should be emphasized in treating water for color removal that the alum should be added first to pick up the color and the silica sol functions merely to attract the small alum floc and roll it up into a dense more readily settling material. By gathering together this very fine alum floc, tho resultant color in the clear well often is greatly improved.

In lime softening of waters, the silica sol also has been of value. The first experiments in its use were conducted in southern waters which were relatively hard and highly colored and here activated silica demonstrated its utility both with alum and sodium aluminate, and sometimes as a coagulant without the alumina complex being present. In northern waters it has also shown similar advantages. It should be noted that, in this particular application, the silica should be added before the lime softening reaction, and at a point where the silica sol and lime will undergo a definite turbulence during the softening reaction.

Silica sol has been shown to be effective in waters during the winter period when chemical reactions are slow because of lower temperatures and it has improved the quality of the water in numerous installations during such periods of difficult coagulation.



AN UP FLOW TYPE UNIT utilizing activated silica to coagulate an industrial waste treatment.

Activated silica sol has successfully removed a high percentage of manganese from water. At one plant water carring 1.1 mg/1 of manganese was under treatment. With coagulation using lime, alum and activated silica sol, 95.3 percent of the manganese was removed in the floc with only 4.7 percent depositing on the filter. Ten times this amount went on the filter when activated silica was omitted.

Summary and Costs

The advantages resulting from the use of activated silica which have been reported are as follows:

1. Improved quality of filtered water.
2. Reduced raw water color by more than 90 percent and reduced turbidity.
3. Broader effective pH range in treatment.
4. Flocculation of widely varied waters, including spring runoffs or heavy rains.
5. Increased compaction of sludge.
6. Increased length of filter runs, use of larger filter media and higher filter rates, especially during periods of cold water, high color.
7. Effective winter and summer coagulation.
8. No "after precipitation" of alum during cold water periods when alum reacts slowly.
9. Reduced chemical cost.
10. Increased equipment capacity; reduced cost of new installation.

As far as the cost of using silica sol is concerned, this will depend on the magnitude of use and also to some extent on the freight rates on chemicals employed. Common figures for approximating this cost of application are 35 to 50 cents per mg/l for each mil gal of water treated. Of course, this represents a gross cost and does not take into consideration economies which are often experienced when silica sol is employed. A recent installation in a steel mill showed almost a 50 percent reduction in water treating cost when activated silica sol treatment was started. In a municipal water supply, the cost per mil gal of water was reduced from $41.41 to $20.72. This is not to imply that there is always monetary saving involved, but it is entirely possible that the additional cost of silica sol is largely offset by economies in other chemicals, as well as by improvements in operating efficiencies, or in water quality.

The opportunity of developing a fast forming, dense, rapid settling floc under varying conditions of temperature and chemical changes is the primary advantage to be obtained by te use of silica sol. The use is growing not only among industries and municipalities for water treatment as such, but also among industrial firms having waste disposal problems which involve coagulation and sedimentation.

Of interest to municipalities is how an industry experimented with . . .

Treatment of Phenols with Sewage

by B. S. GRAVES
Norco Refinery
Shell Oil Co.
Norco, La.

EDITOR'S NOTE: An increasingly frequent meeting today is one between industrial and city officials on the subject of admission of industrial wastes to the city sewer systems. Always in the forefront at these meetings is the question of the effects of the waste on the treatment plant. At the Norco refinery of the Shell Oil Co. the problem was slightly different but the results are definitely of interest to those who are or who might be facing the question of whether to accept phenol bearing wastes into their treatment plants. The problem at Norco was how much phenol removal could be obtained in a trickling filter plant treating, up until these experiments, only the plant's domesitc sewage. Mr. Graves reports in this paper, originally presented at the 1959 Purdue Industrial Waste Conference and published here with permission; that, without utilizing the full potential of the system, 110 pounds of phenol was removed per day without any effect on the treatment plant.

■ OVER THE YEARS petroleum refining in particular has continually been improved with the result that greater volumes of more concentrated phenolic waste streams are produced in the process. The Norco Refinery of the Shell Oil Co. like much of the rest of the industry, had an ever increasing problem with the disposal of such sour waters, as phenol containing wastes are known. With the knowledge that biochemical treatment of such wastes has been found quite advantageous to many others as a basis a program was undertaken to determine if practical use of this process could be made at the plant. Of specific interest was the use of bacterial culture present in the refinery's conventional sanitary sewage treatment plant.

The work progressed slowly, primarily because the quality of the refinery's effluent did not require a crash improvement program, and secondly because operating equipment is involved whose primary purpose is producing saleable products. Operation of the sewage plant as described below must be scheduled so that the experimental program does not adversely affect either refining processes or sanitary sewage treatment.

Table I

Typical Phenol Reduction Data

		Range	Average
Sour Water,	mg/l	80-185	140
	gpm	8-70	
Untreated Sewage,	mg/l	9-26	15
	lb/day	15-43	26
Treated Sewage,	mg/l	0.6-3.8	1.8
	lb/day	1-6	3
Phenol Reduction,	%		88
Temperautre, °F		72-110	
pH		7.4-9.9	9.0

Laboratory Work

A laboratory study was launched first to review the general mechanism of bacterial action as well as to determine the specific varieties of bacteria available in the sanitary sewage plant. The biochemical treatment is generally conceded to be influenced by these seven environmental factors: 1. Temperature, 2. Metabolic Lag 3. Nature of Initial Microbes, 4. Phenol Concentration, 5. Specific Phenols, 6. Nutrients, and 7. pH.

Temperature. The optimum temperature for maximum oxidation of phenols by bacteria has generally been found to be about 90°F. Success has been achieved with temperatures as high as 140°F. An appreciable decrease in temperature drastically reduces the ability of the bacteria to oxidize phenols.

Metabolic Lag. Metabolic lag is the period of change which a bacterial culture must undergo in acclimating itself to a changing environment, in this particular case a changing food supply. We have not included an evaluation of this factor in our current study. It was sufficient to know

that such a period would be experienced.

Nature of the Initial Microbes. Samples of bacterial slime were taken from the trickling filter and examined by microscopic and culture techniques. Two types of bacteria were found; gram negative, non-sporing rods, and gram positive sporing rods. The bacteria were classified as *Achromobactor pseudomonas* and *Bacillus subtilis*. Both are non-pathogenic and normally occur in air and water. *Achromobactor pseudomonas* was found to oxidize phenol in our laboratory tests. Samples of sludge taken from the Imhoff tank also contained this bacteria. Bacterial counts were not made due to the non-homogeneity of the slime on the rocks in the trickling filter and of the sludge from the Imhoff tank. Phenol destroying bacteria have been broadly classified in the literature as monas type[2], pseudomonas type[3], and more specifically as *Pseudomonas cruciviae*.* The latter type, we understand, was found to predominate in a Dow Chemical Company system[1, 4] and is identical to that present in our system.

Phenol Concentration. Bacteria have the ability to become acclimated to and to oxidize various concentrations of phenols up to 1000 mg/l. However, if the phenol in a specific area is suddenly increased to a much higher concentration many of the bacteria are killed. The surviving bacteria are more resistant and give rise to a strain capable of oxidizing higher concentrations of phenols. On the other hand, if the increase is gradual the bacterial population is not altered to a large extent.

The concentrations or influence of all specific phenolic compounds present was not determined since there is relatively little which can practically be done to alter petroleum processing as a result of such information.

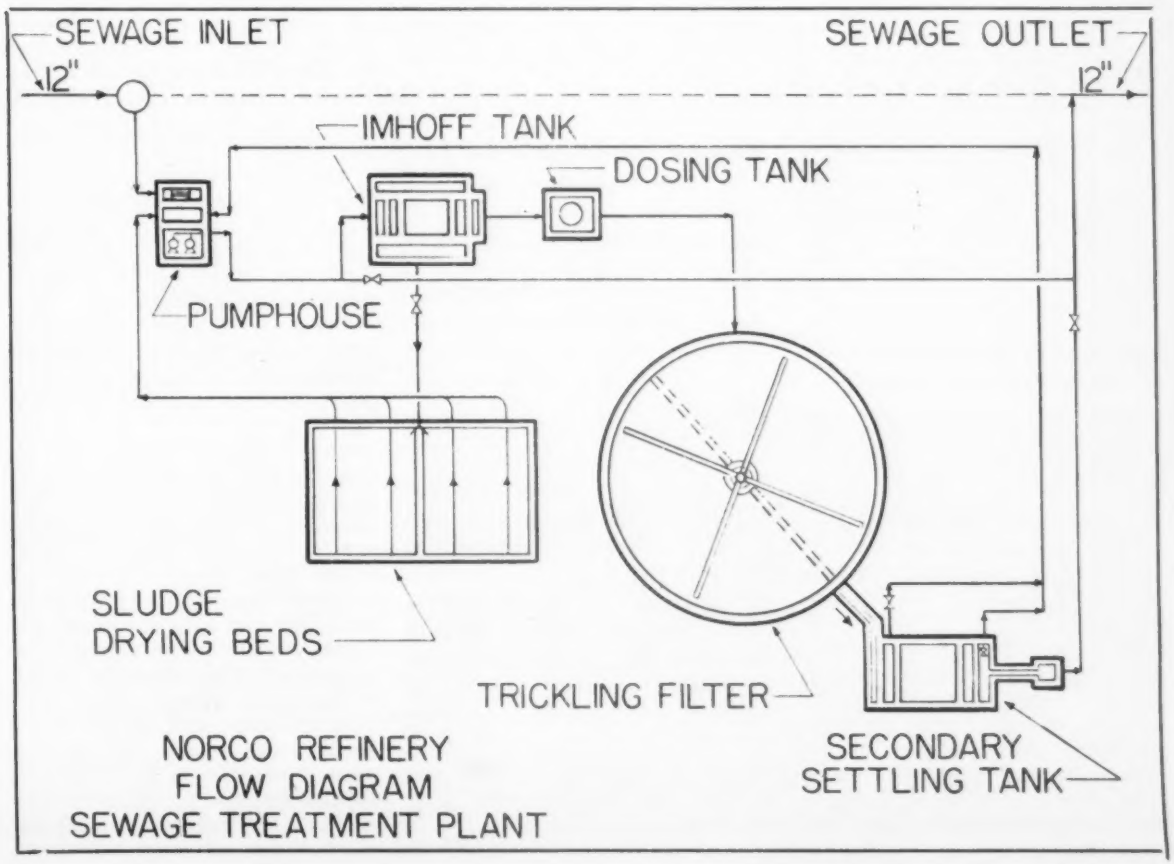
Nutrients. Bacteria require the nutrients carbon, hydrogen, oxygen, nitrogen, and phosphorus for life. The bacteria in question are able to use phenolic compounds for their source of carbon. Nitrogen and phosphorus occur normally in sufficient quantity in domestic sewage. Oxygen requirements of the bacteria must also be met for proper respiration. Without oxygen they are unable to carry on the process of assimilation, motility, and other essential cell activities.

Hydrogen ion concentration. In addition to the foregoing factors, the pH of the waste water is also considered to be a factor in bacterial oxidation. pH values ranging from 6 to 10 have been reported as those at which most activity occurs. This again is a case of acclimation and sudden changes in pH should be avoided. At Norco the phenolic waste process water averages a pH of 9.5 while the outfall from the trickling filter is fairly constant at 9.0.

Plant Trial

Since existing conditions and preliminary laboratory results were quite promising, it was decided to make a plant trial, adding a phenolic

*Also known as *Achromobacter cruciviae*



water stream to the influent of the refinery sanitary sewage treatment plant. This plant, (Fig 1) is conventional in design and construction.

Over a period of 12 months, sour water input to the sewage system was increased in increments to 70 gpm, so as not to shock the bacteria. Total phenol reduction has been relatively constant, throughout this period. Of particular interest in the phenol concentration gradient as flow proceeds to and through the sewage treatment plant. The waste water is added to the sanitary sewage some 3000 ft upstream of the Imhoff tank. The sewer main is a woodstave line with a number of manways, each of which can admit oxygen. Table 1 summarizes the important operating data and illustrates the range of conditions encountered.

Attempts to make phenol balances have shown that there is about a two-thirds reduction between the mixing point and the sewage plant entry. Of the remaining phenol, some 5-10 percent is destroyed in the Imhoff tank, 80-90 percent in the trickling filter and up to 5 percent in the secondary settling tank. Thus, the sanitary sewage plant itself effects a phenol reduction of 85-90 percent.

Summary

In summary, then, it can be said that it has been possible to destroy some 100 pounds of phenolic compounds per day by biochemical treatment of 70 gpm of waste process water in the sanitary sewage treatment unit. This improvement of refinery effluent is significant. It results from an experimental program whose maximum potential has not yet been realized. The oxidation capacity of the existing sewage plant has not been determined since no deterioration of stability or clarity of the effluent has occurred. It is planned to increase phenol charge rate towards the practical maximum.

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Sewer Pipe Requirements Grow

Almost two billion feet of sewer pipe and fittings will be required by sewerage utilities for new construction, maintenance and repair between 1959 and 1975, to provide adequate public sewerage facilities by 1975, according to the Water and Sewerage Industry and Utilities Division, Business and Defense Services Administration, U.S. Department of Commerce.

Disposal of Radioactive Wastes—Store or Dump?

Studies of radioactive waste disposal methods continue without the final answer. The U.S. and Great Britain seal up and dispose of atomic wastes at sea, Russian scientists believe storage is the better means.

Supporting the Russian viewpoint is scientist N. Bogorov. He concludes that the ocean contains no stagnant zones, circulation occurs everywhere down to the ocean floor. Bogorov heads an expedition conducting oceanagraphic research aboard the Vityaz. "Wastes dissolved in water at great depths will not remain there", according to a release by Tass, but will quickly rise to the surface. Strontium-90 and other radioative substances will be assimilated by plankton, then by plankton-eating fish and will become a hazard to human life."

Monster Valve Installed at L.A.

A 120-inch diameter, class 50-8, hydraulically controlled, rubber-seated butterfly valve is just part of the massive equipment being installed in the new Hyperion effluent pumping station under construction in Los Angeles.

Largest of its type ever built at Allis-Chalmers, West Allis Works, the valve has been tested at 100 psig, twice the maximum operating pressure it will work against. Normally used as a shutoff, the valve is hydraulically controlled by a mechanism at 2500 psi, the highest control pressure yet used by the manufacturer.

The pumping station is scheduled for completion in 1960 and will include other equipment representing the largest of their type built by Allis-Chalmers. These are the three 54-inch pumps rated 120,000 gpm at 80-ft head, equipped with 2500 hp, vertical, wound-rotor motors.

Sewers and Civilization

The Portland Cement Association has published an attractive booklet entitled "Sewers and Civilization." It is a nontechnical presentation for the purpose of helping cities and sanitary districts pass bond elections for sanitary sewers.

The history of sewers and sewage disposal of ancient civilization is described and illustrated in a simple manner. Later needs of the Middle Ages are shown and subsequently modern scenes are depicted.

The Association will provide copies of the booklet to cities and sanitary districts to use as part of their basic public relations program in public education.

Write: Portland Cement Association, 111 West Washington St., Chicago 2, Illinois.

• "Growing population and accelerating technology are prime factors in complicating environmental problems. Therefore, more, better and differently qualified sanitary engineers are required. They should be attracted by a more adequate public relations campaign, and should be financially supported at the academic training levels especially in the undergraduate years."

—Butrico and Hollis

The need for a safe dependable water supply in a suburban area resulted in the development of the . . .

Inman-Campobello Water District

by E. M. ANDERSON, Supt.
Inman-Campobello Water District
Inman, South Carolina

EDITOR'S NOTE: Steady growth of both the residential and industrial population of Inman, S. C., its neighbor Campobello and the rural area surrounding them made the need for a water system to serve this suburban area of Spartanburg obvious. By 1955 the inadequacy of the Inman water system and the fact that Campobello could no longer grow without a public water supply became apparent. The problems facing these two cities and their rural neighbors were: where to locate a source of supply, how much water to provide so as to be ready for future growth and how to properly serve an area of twenty-five square miles with a 300 ft difference in elevation at a cost for water that was within reason. How these problems were answered is told here.

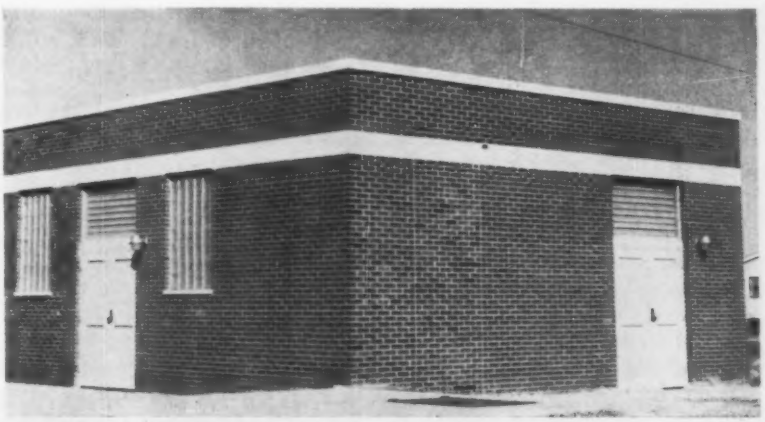
■ THE SERIOUS DROUGHT of 1954, which taxed to the limit the Inman Water Works, pointed up the need for a new evaluation of the present and future water needs of the area. The five pumps and 22 wells serving the incorporated town of Inman could not provide sufficient water during peak periods or for maximum fire protection. On January 1, 1955, 578 services were connected to the Inman Water System, with maximum consumption at the rate of 150,000 gpd. There had been a rapid increase, both in numbers of manufacturing plants entering into the area, and in the size of existing plants. This trend seemed sure to continue, making an adequate water supply a prime necessity.

Establishment of a District

Campobello, an adjacent incorporated community, had no water supply system, other than private wells. In addition an estimated 5300 people lived in the rural area outside the two incorporated towns. Discussions of the idea of a water district for the area developed that the potential users in Inman, Campobello, and the Boiling Springs area plus the rural population which could connect amounted to approximately 4000 people who could be served by some 1000 services almost at the outset of a water district.

To the problem of locating the best source of supply three solutions presented themselves: more wells, a pumping station and filtration plant on the South Pacolet River, and to buy the water from the Spartanburg Water Works which supplied the city of Spartanburg.

The use of wells was eliminated on the basis that more and more wells would be needed as the area's population and industrial needs increased. Also the widely separated, individually operated wells would not lend themselves to economical or simple control. A filtration plant alone, assuming the South Pacolet River could



EXTERIOR VIEW of the booster pumping station

OFFICE OF THE DISTRICT at Inman with the 75,000 gal elevated storage tank in the background

supply future needs, was estimated to require a capital investment of $300,000 plus a 24-hour operation requiring skilled personnel. In as much as discussions with the Spartanburg Water Co. indicated that they were able and willing to supply the District with water it was decided to use this source of supply and proceed with the establishment of a water district.

Since an incorporated town cannot supply water indiscriminately to areas outside their corporate limits, the Inman-Campobello Water District was created by the South Carolina Legislature in 1954, to encompass an area of 25 square miles. Construction of the Inman-Campobello Water System began in 1955.

Design Factors

Based on past population increases, Spartanburg County is expected to have a population of 225,000 by 1980, of which 150,000 will live in the country outside the township of Spartanburg. The Inman-Campobello Water District population should increase to a total of 8810 by 1976. Since adequate water supply is a prime factor in attracting industry and since such new industries could be expected to accelerate the growth of the area, it was decided to base the design on an estimated population of 10,000 in 1976 and on a per capita consumption of 60 gals per day.

It would have been unwise from an economic point of view to forego the potential of industrial customers, by building a system sized only for domestic use and fire protection, because industrial demand could not be adequately predicted. A figure of 3 mgd was therefore adopted for design purposes although it is above that needed for adequate fire protection. This approach was possible because Spartanburg had sufficient water to supply the district and agreed to do so for 30 years. At the present time Spartanburg Water Works is building another dam to retain another 9,000,000,000 gallons.

System Design Connections to the Inman-Campobello Water District were made in the Boiling Springs area from the 24 in. and 27 in. lines of the Spartanburg Water Works leading from its filter plant at Boiling Springs to the city of Spartanburg. An 18 in. main carries the water from this point to the booster pumping station, a distance of some 17,900 feet. From the booster pumping station, a 12 in. line of 15,500 feet in length extends about three miles southeast along US 176 to the Hayne Shopping area. A 16 in. line of 31,500 feet in length was constructed to carry water from the booster pumping station for approximately six miles northwest along US 176 to the reservoir, which consists of two 500,000 gal welded steel tanks. This 16 in. line was used in as much as the line linking the pump and reservoir would determine the quantity of water which could be supplied to customers through the future years without duplication of lines or additional storage reservoirs. From the reservoir, for approximately two miles northwest along the highway to a point passed Gramling, a 12 in. line was constructed. This then becomes a 10 in. line the rest of the way, two miles, to Campobello. These lines were sized on the assumption that they would provided adequate flow for fire protection wihout excessive friction loss. If greater pipe capacity is needed later to supply actual consumption friction loss at time of peak demand can be lessened by providing storage capacity in this area.

An 8 in. line runs from US 176 to the existent Inman Water Works joining at the junction of two 6 in. lines. They feed into an existing 75,000 gal elevated tank at Inman. This tank was reconditioned, and while not necessary to the system, it insures approximately equal pressure with Campobello, which is 50 to 60 ft lower than Inman. The reservoir is 11 ft higher than the tank at Inman which is equipped with an altitude valve to prevent its overflowing. Water pressure at Campobello is 75 psi, at Inman 60 psi. Maximum pressure in some low areas reaches 120 lbs. This pressure is controlled by reducing valves at each home, if wanted, at a cost of $7.50 plus installation.

Controls

To appreciate the advantages of the new system with the automatic control equipment, consider the old system which had five pumps, two equipped with 10 hp motors, two with 5 hp motors, and one with a 2½ hp motor, serving 22 wells each averaging 150 ft deep. These were individual wells located in the vicinity of Inman. Each pump was individually and manually controlled. The system required 24-hour supervision, one man operated the pumps each 12-hour shift, and in case of trouble, both men were on call. Water level in the 75,000-gallon elevated tank was visually checked, and pumps were started when water was needed to fill the tank. Six power meters alone were required in the old

system, costing $250 to $300 per month to operate.

Today one meter is used costing $150 per month for three times the amount of water. Two men operated the old system, today six men are used; 1 superintendent, 1 clerk, 1 serviceman, and 3 laborers. In 1955, 640 homes were served by the Inman Water Works, supplying approximately 40,000 gallons per day. Today, the Inman-Campobello Water District serves 1175 homes, consuming 250,000 gpd.

In the system today, the pumps are under automatic control. One unit is located at the reservoir, mounted outdoors onto the tank side. This unit, which is air tight and water tight and tamper proof, is the transmitter. A thermostat controlled heating element inside the transmitter case, maintains a constant temperature to prevent freezing and moisture condensation. As water level in the tanks lowers 2½ ft the change in pressure is sensed by a pressure type level measuring unit and the transmitter signals over telephone wires to the receiver in the pumping station, to start one pump. One pump can raise the water in the tank 1 ft per hour. If this is not fast enough to keep up with the demands and water level drops to 3 ft then the transmitter orders #2 pump to start. Should the level lower to 4 ft, the #3 pump will cut in. The serviceman, who also maintains the pumps, does not maintain a constant watch at the pump house and checks only once a day. Since the reservoir will hold a four day supply of water and the automatic controls will protect the equipment from damage, any trouble from electric lines or water pipe does not reach an emergency stage. The pumps operate in three stages to equalize wear of pumps. If the pumps were connected to alternate 1, 2, 3, then pump No. 1 would operate almost constantly, with pumps #2 and #3 having very little work to do. To equalize the wear on all pumps, a control located in the lower part of the receiver advances after each pump finishes its work. This automatically makes the next pump cut in first on the next run. Outside the pump house is a 6" Pelton surge suppressor. A sudden surge of water from any water line will close this valve to suppress the surge that might damage the pumps from back pressure.

The two reservoir tanks which are 67½ ft by 20 ft high are floating on the line. The automatic controls are mounted on one tank only. Although it would have been less expensive to build one reservoir tank of 1 mil gal capacity, rather than two of 500,000 gallons capacity each two were provided to simplify tank painting and maintenance.

Fire protection services are provided to stores and industries on the basis of a monthly charge for each head in the sprinkling systems. The charge is 5 cents per head in the district, 7½ cents per head for warehouses outside. In event of fire, water which flows through the sprinkling system and lines will not be metered and no further income will be earned by the district for water consumed.

The entire Inman-Campobello Water District involved an expenditure of $1,000,000. Total cost of electrical controls was $5,000. The automatic equipment which was supplied by the Automatic Control Co. was installed for $2,591. Cost of water at Spartanburg is 12½c per 1000 gal. Pumping capacity is 3 mgd and can be pushed to 4.5 mgd if necessary. Cast iron pipe is used throughout the system.

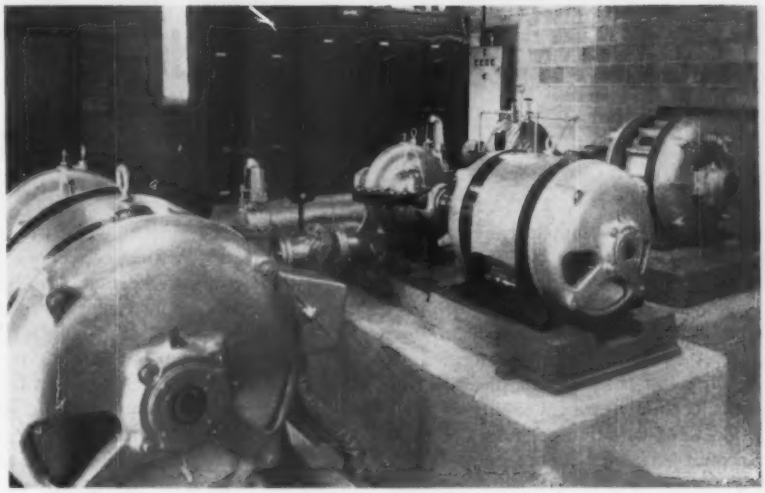
Service to customers is metered. Minimum rate is $2.50 for 3000 gallons.

The next 2,000 gallons @ 50c per 1,000.

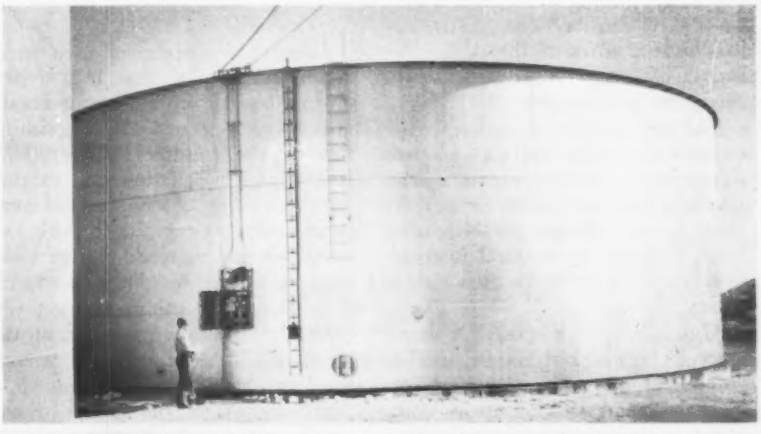
The next 10,000 gallons @ 40c per 1,000.

The next 20,000 gallons @ 35c per 1,000.

The next 40,000 gallons @ 30c per 1,000.



THE INTERIOR of the booster pumping station showing the pumps and automatic controls



MAIN RESERVOIRS with the automatic control box open for inspection by the serviceman.

Dear Bill:

How do you prevent those tension buildups?

You missed our last get-together Bill. Been tired? Have that tread-over feeling? Walls closing in on you again?

Few indeed are those who have never been forced to face tensions in their jobs. It's seldom a pleasant feeling; certainly never a profitable situation. Nervous and physical tensions reduce efficiency, lower one's health, make the simplest tasks more difficult and generally are a most profitless condition. Agreed?

Experts tell me that fully 90 per cent of such tension troubles among business and professional men could be avoided. The application of their suggestions is a simple step to take and the results obtainable most valuable.

First, look for the day-in and day-out long routine parts of your chores. These are sure and certain tension builders upon even the most perfect physical specimen. Routine is always a villian when it comes to creating business nerves.

There are, of course, numerous such routines in the daily life of every individual which are a necessary part of the job and cannot be done away with. If some can be disposed of, do it. However, the average solution will be spreading such routines out over the entire day rather than stacking each up one after another. There also may be instances where tension-building long routine work chores can be broken up into sections and tackled at different parts of the day rather than all at once. Wherever possible, this is the best solution.

The lack of use of muscles tends to tighten them up and with it comes tightening and tenseness of nerve ends involved thereon. Sitting in an office chair, as an example, for hour after hour, without any physical interruption is a clear invitation to a case of jitters.

Muscular (and don't forget, nerve as well) relaxation can be attained by nothing more than getting up from your desk and walking about, down a hall, to another part of the building, or simple "stretching" exercises in front of a window. Capturing a little fresh air in the system while this is being done adds to its effectiveness.

Another thing to keep in mind is that it is always a lot easier to relax by stopping to take a deep breath before tackling any tension-building job. Next time you're watching a professional golf match on the course or on television notice how practically every pro does just this before he makes an important putt on the green. He long ago found that it pays to secure relaxation and freedom from nervous tension at this moment by doing just this.

Just as it works for him in his job so it can obtain the same results for you in your work. Not only does this relieve such tensions which may already be present but it permits you to tackle the up-coming difficult problem fully relaxed and avoids any additional tension build-up while the job is being done.

But never forget, nerves and tensions build up through lack of use of body muscles and that's every individual's big problem unless he does something about it. Seeing to it that you work relaxed as much as you can and inter-mix chores with mild physical efforts will avoid a good half of most such tension build ups.

Time and again I have heard this advice given by men who make a study of the problem: "When you feel tension coming on—STOP—that's the time to get away from the job at hand for a moment or two."

When you dispose of each small accumulation of tension as it arises, the big build-up to a nervous breakdown never occurs. Accomplishing this can be possible by everything from simple relaxation and looking out the window to some form of completely different exercise or work, i.e., an abrupt and complete change away from the tension-building procedures.

What are the things that get you riled up and always annoy you on the job? All of them are sure tension builders. Make a list of them. Examine every such point closely. Some may be your own fault and self-adjustment to them is then in order and not difficult to accomplish once you are aware of what has to be done.

There usually exists a solution for just about every one of these conditions or situations. Once the tension-builder list is made start disposing of them one by one—in fact the process of doing so will in itself serve as a valuable tension reliever. Close study of the list may also reveal many as actually not being as important as you had thought them to be.

The surest way in the world for you to have a perpetual case of nervous-jitters is to waste time anticipating such business troubles and problems in advance of the need for handling them.

By the way I have also been told in many a case that it is seldom wise to rely too much on mechanical stimulating means of reducing such tensions. By this I refer to such things as cigarettes, drinking, "Yogi" rites, etc. —all are nothing more than crutches and never get at the base of the real problem. In many instances such methods do nothing more than supplant a major tension builder with a minor one so that things seem less exacting than they really are.

Are you attempting to do too much in too little time? That is a most prevalent cause of tension building. After all there's always tomorrow and there are always a lot of other people around to help with any chore or problem. Wise indeed is the man who well knows his capacities and never attempts to push himself beyond these. Each step taken in the excess direction always brings him a pace closer to nervous exhaustion. And when this happens what good has been accomplished by trying to do too much in too little time?

Finally, it seems to me that a person should get away from the day to day routine. A good way to do this is by coming out to our meetings. Everyone brings their problems with them and leaves the majority of them there.

Isolation is itself a tension builder. See you next month.

Sincerely,
Will

Ed. Note: This "Dear Bill" submitted by William J. Milford

FLUIDICS* AT WORK

New Simplex telemeter reads and controls 2 to 29 channels

The new Orthoplex telemetering system uses a biplex generator and biplex selector to achieve dual signal telemetering using a single pair of telephone lines.

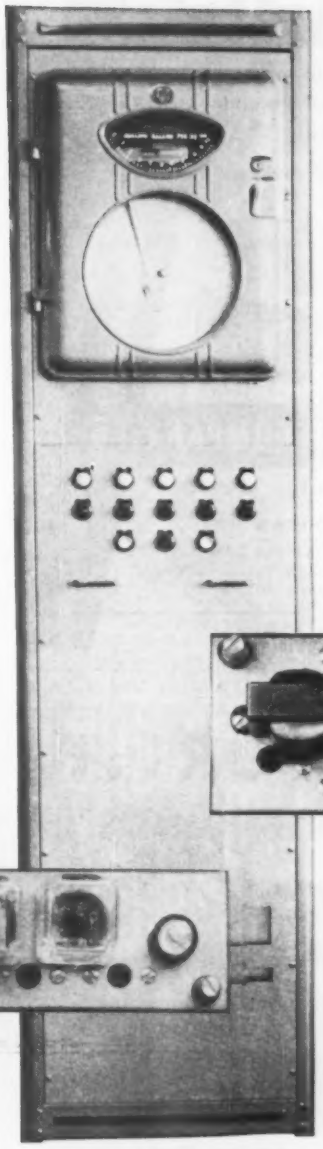
In the basic system the generator produces both a dc and a 60-cycle ac signal which is unscrambled at the receiving end by the selector. These 2 signals are fed into a multiplexing unit which provides the extra channels.

Uses ac and dc signals—Combining ac and dc currents produces a circuit less affected by line capacitance and able to give a longer distance transmission with available capacitance.

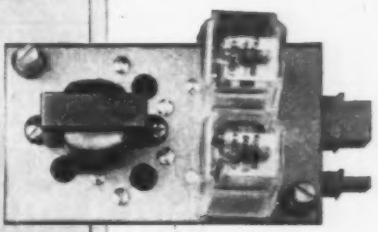
The new system requires much less maintenance than previous designs. It uses no vacuum tubes, eliminates all motorized timers and motorized sequence switches; and the modular units are equipped with "quick-disconnect" connectors, plug-in relays, and rectifiers of advanced design.

Modular design—The modular design allows building up as many as 29 separate channels for supervisory indicators, alarms, telemeter receivers, pump controls, valve positioners, etc.

For complete specifications and design theory, write for bulletin to our Simplex Division, Dept. WS-129, Lancaster, Pa.



SIMPLEX Orthoplex Supervisory Control provides you with a system for remote control of valves and pumps from a central station.



BIPLEX Selector separates signals so they operate relays sensitive only to their assigned signal.

BIPLEX Generator is designed to give two signals, a positive dc and 60-cycle ac.

*FLUIDICS is a new Pfaudler Permutit program which provides a modern, imaginative approach for handling and processing liquids and gases more profitably.

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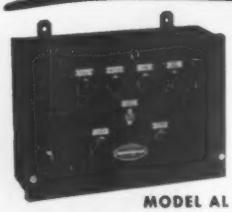

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Your engine can be protected by being automatically shut down at the first sign of low oil pressure, high water temperature, overspeed, etc.

The AL series of Synchro-Start Controls is made to fit individual requirements. Your specifications sent to us will bring immediate response.

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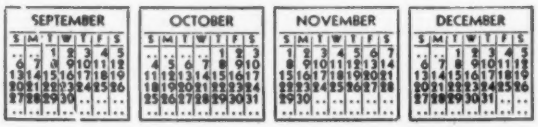


Jan. 6-8—Cincinnati, O. (*Hotel Netherland-Hilton*)
Conf. on "ECONOMICS OF POLLUTION CONTROL" sponsored by SANITARY ENGRG. DIV. ASCE.

Jan. 20-22—New York City, N. Y. (*Park-Sheraton Hotel*)
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSN. Exec. Secy: R. C. Sweeney, State Dept. of Health, 21 N. Broadway, White Plains, N. Y.

Jan. 25-29—Cincinnati, O. (*Taft Sanitary Eng. Center*)
Course on "RECENT DEVELOPMENTS IN WATER BACTERIOLOGY." Write: Training Program 4676 Columbia Pkwy., Cinn. 26, Ohio (or to USPHS Regional Office

Jan. 27-29—Urbana, Ill. (*University of Illinois*)
CONFER. 2ND SANITARY ENGRS. sponsored by the State Dept. of Pub. Health and the University's Dept. of Civil Engrg. Subj: "RADIOLOGICAL HEALTH ASPECTS OF WATER SUPPLY." Write: William J. Downer, Asst. Chief San. Engr., Dept. of Pub. Health, Springfield, Ill.

Feb. 1-5—Chicago, Ill. (*Sherman Hotel*)
ASTM Committee Week

Feb. 3-5—Indianapolis, Ind. (*Sheraton-Lincoln Hotel*)
INDIANA SECTION, A.W.W.A., Secy: C. H. Canham State Brd. of Health, 1330 W. Michigan St., Indianapolis.

Feb. 14-18—New York, N. Y. (*Hotel Statler*)
AMERICAN INSTITUTE OF MINING, METALLURGICAL & PETROLEUM ENGINEERS.

Feb. 21-24—Atlanta, Ga. (*Biltmore Hotel*)
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.

Mar. 14-18—Dallas, Texas (*Memorial Auditorium*)
Annual Convention NATIONAL ASSOCIATION OF CORROSION ENGINEERS.

Mar. 16-18—Chicago, Ill. (*Pick-Congress Hotel*)
ILLINOIS SECTION, A.W.W.A. Secy: D. W. Johnson, Research Engr. Cast Iron Pipe Research Assn., 3440 Prudential Plaza, Chicago 1.

Mar. 17—Boston, Mass. (*Statler Hotel*)
NEW ENGLAND SECTION, A.W.W.A. Secy: R. M. Soule Assoc. Sanit. Engr. State Dept. of Public Health, 511 State House, Boston.

Mar. 20-23— Savannah, Ga. (*DeSoto Hotel*)
SOUTHEASTERN SECTION, A.W.W.A. Secy: N. M. de Jarnette, Engr. Water Quality Div., State Dept. of Public Health, 309 State Office Bldg., Atlanta.

Mar. 23-24—Huntington, W. Va. (*Hotel Pritchard*)
WEST VIRGINIA SECTION, A.W.W.A. Secy: H. W. Hetzer, Engr., Union Carbide Chem. Co., Box 8361 South Charleston.

Mar. 23-24—Huntington, W. Va. (*Hotel Pritchard*)
WEST VIRGINIA SEWAGE AND INDUSTRIAL WASTES ASSN., Secy-Treas: Glen O. Fortney, St. Dept. of Health, Charleston 5, W. Va.

Apr. 1—Atlantic City, N. J. (*Hotel Traymore*)
NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSN. Secy: A. T. Leahey, P. O. Box 32, W. Trenton.

Apr. 3-8— New York City, N. Y. (*Coliseum*)
6TH NUCLEAR CONGRESS sponsored by EJC and other engineering and scientific societies including A.W.W.A.

Apr. 5-7—Binghamton, N. Y. (*Sheraton-Binghamton Hotel*) NEW YORK SECTION, A.W.W.A., Secy: Kimball Blanchard, N. Y. Branch Sales Off., Neptune Meter Co., 2222 Jackson Ave., Long Island City.

Apr. 5-14—Cleveland, O. (*Hotel Netherland-Hilton*) NATIONAL MEETING—AMER. CHEM. SOCIETY DIV. OF WATER & SAN. CHEMISTRY Symposium on Indust. Wastes in conjunctn. with 137th Meeting., Prof. C. Fred Gurnham Head of Dept. of Chem. Engrg., Michigan State Univ., E. Lansing.

Apr. 7-8—Raleigh, N. C. (*State College Campus*)
9TH ANNUAL MUNICIPAL & INDUST. WASTE CONFER. Write: The Div. of College Extn., P. O. Box 5125 State College Sta., Raleigh, N. C.

Apr. 20-22—New York, N. Y. (*Manhattan College*)
THIRD BIOLOGICAL WASTE TREATMENT CONFER. Write: W. Wesley Eckenfelder, Assoc. Prof. Manhattan College, New York 71.

Apr. 20-22—Lincoln, Neb. (*Cornhusker Hotel*)
NEBRASKA SECTION, A.W.W.A. Secy: J. J. Rossbach Jr., Civ. Engr. Metropolitan Utilities Dist. 3906 N. 48th St., Omaha.

Apr. 20-22—Emporia, Kan. (*Broadview Hotel*)
KANSAS SECTION, A.W.W.A., Secy: H. W. Badley, Repr., Neptune Meter Co. 119 W. Cloud, Salina.

Apr. 22—Monterey Cal. (*Mark Thomas Inn*)
CALIFORNIA SECTION, A.W.W.A., Secy: R. E. Dodson, Jr., Supt. of Water Dept. of Utilities, Balboa Pk., San Diego.

Apr. 22-24—Emporia, Kan. (*Broadview Hotel*)
KANSAS SEWAGE AND INDUSTRIAL WASTES, ASSN. Secy-Treas: James F. Aiken, 1900 E. 9th St. Wichita

Apr. 24-26—Buffalo, N. Y. (*Statler Hotel*)
CANADIAN SECTION, A.W.W.A., Secy: A. E. Berry, 72 Grenville St., Toronto, Ont.

Apr. 28-30—Billings, Mont. (*Northern Hotel*)
MONTANA SECTION, A.W.W.A., Secy: A. W. Clarkson, Asst. Dir., Div. of Envirn. Sanit. State Board of Health, Helena.

Apr. 28-30—Billings, Mont. (*Northern Hotel*)
MONTANA SEWAGE & INDUST. WASTES ASSN. Secy-Treas: A. W. Clarkson, Div. of Envirn. Sanit., State Brd. of Health, Helena

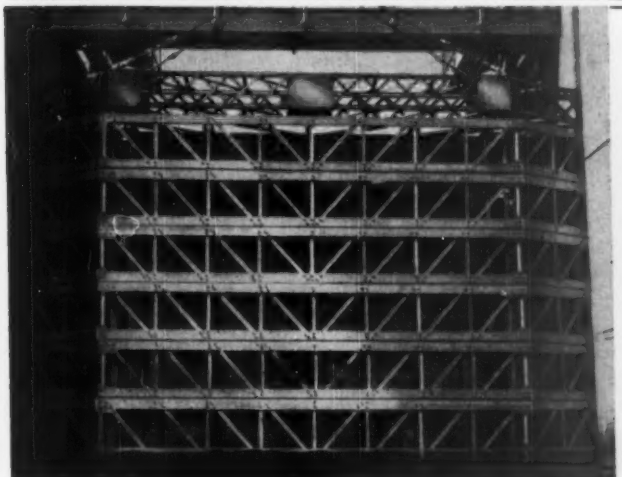
May 4-6—Portland, Ore. (*Benson Hotel*)
PACIFIC NORTHWEST SECTION, A.W.W.A., Secy: F. D. Jones, W. 2108 Maxwell Ave., Spokane 11, Wash.

May 15-20—Miami Beach, Fla. (*Bal Harbour Hotel*). A.W.W.A. CONVENTION

Jun. 12-17—Madison, Wis. (*Lorraine Hotel*)
CENTRAL STATES SEWAGE & INDUST. WASTES ASSN., Secy-Treas: Scott A. Linsley P. O. Box 3598, Childs Rd., St. Paul, Minn.

Jun. 19-22—Mexico City, Mexico (*Del Prado Hotel*)
MEETING OF AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

Jun. 20-24—Scarborough, England
INSTITUTE OF SEWAGE PURIFICATION, England Secy: W. F. A. Snook, 10 Cromwell Pl..So. Kensington, London, S. W. 7, England



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Engineers who want to reduce installation costs and corrosion problems specify Washington Aluminum maintenance-free equipment. Washington Aluminum proven-in-use design and fabrication products makes this name a mark of distinction on every installation.

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News of Suppliers

CONTINUED FROM PAGE 32A

by served three years in the Pacific theater of operations as a B-24 flight engineer with the Army Air Force. He is an active member of the Federation of Sewage & Industrial Wastes Association, and past-chairman of the Texas Municipal Contractors associate group.

Southern Pipe Building Hawaiian Plant

Southern Pipe Division of U. S. Industries, Inc., Azusa, Calif., has announced that construction of a steel pipe fabricating and processing plant in the Hawaiin Islands has been started.

The new plant is located on a 4-acre plot in the Campbell Estates Industrial Tract at Barbers Point on the south coast of the Island of Aahu, west of Pearl Harbor.

First pipe from the new plant will fulfill Southern Pipe's recently awarded $600,000 contract with the Board of Water Supply for the City and County of Honolulu.

As rapidly as possible the Hawaiian facility will be expanded to the end that Southern Pipe can make available a complete range of pipe sizes from 4 to 48 inches with all types of coatings and linings including cement-mortar, coal tar, asphalt, and various wrappings.

Union Tank Acquires Smith & Loveless

Union Tank Car Company, Chicago, Ill., has announced the acquisition of Smith & Loveless, Inc., Lenexa, Kansas, manufacturers of factory-built sewage pumping stations and sewage treatment plants.

The purchase is effective December 1, with Smith & Loveless becoming a division of the Union Tank Car Company. The founding partners of Smith & Loveless, B. Alden Smith and Compere Loveless, will continue to direct the operations of the new division.

It was noted in the announcement that the waste treatment market served by Smith & Loveless is closely related to the municipal and residential water treatment market already served by the Lindsay, Graver Water Conditioning and Graver Tank divisions of the Union Tank Car Company.

American Vitrified to Build East Coast Plant

The American Vitrified Products Co., Cleveland, Ohio, will construct a new $4 million plant for the production of vitrified clay pipe and kindred products on the East Coast.

This plant, to be located in Somerville, N. J., will be completely automated and the most modern ever to be build in the industry.

Situated on an 87-acre tract of land, adjacent to two main railroads and highways, this new plant will afford the opportunity for American Vitrified Products Company to make quick deliveries to the Eastern Seaboard and New England area. The company was previously unable to adequately serve this area because of restrictive fright rates.

In addition to the production of regular clay pipe with all fittings, this plant will have extensive facilities for the production of "Amvit" jointed clay pipe.

Yeomans Opens New York Branch

Yoemans Brothers Company, Melrose Park, Ill., has opened a direct factory branch sales office in New York. The New York office will serve the same areas in the states of New York and New Jersey as previously handled by Turbine Equipment Company, sales representatives of the manufacturer for many years.

Frank J. Smith will be in charge of the new office, insuring experience and continuity in the handling of sales and service requirements for Yoemans pumps, compressors, pneumatic ejectors, sewage treatment equipment and other products. Smith, a mechanical engineering graduate of Stevens Institute of Technology, had been with Turbine Equipment Company for 15 years, serving as Assistant Sales Manager of the drainage and sewage equipment division for the past two years.

Turbine Equipment Company has elected to withdraw from the Machinery Sales business and will continue as an entity with their manufacturing and construction divisions operating out of their Mountainside, N. J. plant and office.

Smith-Scott Adds Cement-Mortar Line

Smith-Scott Co., Inc., Riverside, California, has announced the addition of Cement-Mortar Lined/Cement-Mortar Coated steel water pipe to its product line.

New facilities recently completed in Smith-Scott plants in Riverside, California, and also at Pleasant Grove, Utah, apply cement-mortar coatings to steel water pipe 4" to 36" diameters.

Wheelabrator Buys Lake Erie Machinery Corp.

Wheelabrator Corporation, Mishawaka, Ind., manufacturer of airless blast cleaning equipment, dust control equipment, and steel abrasives, has announced the acquisition of the Lake Erie Machinery Corporation of Buffalo, N. Y.

The newly acquired firm will operate as a wholly-owned subsidiary of Wheelabrator, and will continue to manufacture a variety of hydraulic and extrusion presses for the metal processing industries, and die casting machines and other equipment for the printing industry.

Coinciding with the new expansion, several executive appointments have been announced.

Elmer A. Rich, III, has been named Vice-President and General Manager of Lake Erie Machinery Corporation, with headquarters in Buffalo. He was formerly General Sales Manager of Wheelabrator.

Mr. J. F. Connaughton, President and Director of Wheelabrator will serve in that capacity for both firms. Mr. Robert E. Dillon, who was President of the Lake Erie Corporation, has retired. He has been elected Chairman of the company's Executive Committee and will serve in a consulting capacity to Mr. Connaughton.

Larson to Represent Griffin Wheel Pipe Div.

Griffin Wheel Company, Pipe Division, has announced the appointment of John L. Larson as Sales Representative, operating directly from Council Bluffs, Iowa.

Before joining the newly created Pipe Division of the Griffin Wheel Company, Mr. Larson was District Sales Representative for the Rutland Railway Corporation in Kansas City, Missouri.

New Bulletins

AVAILABLE FREE

All-Power Sewer Cleaners

1223

O'Brien Manufacturing Corp., Chicago, Ill., announced the release of a new brochure comprised of bulletin pages describing the several models of Sewerking, all-power, cable-type sewer cleaners.

These bulletins present the mechanical details and illustrate the Sewerking models, 250, 350 and 800, which are designed to clean municipal sewers and water lines and for threading for buckets. Also included is a bulletin describing the complete O'Brien line of accessories for sewer cleaning machines of the sectional rod type.

Bulletin On Mechanical Seal Failure

1224

Water Service Laboratories, Inc., New York, N. Y., has published a bulletin describing some common causes of mechanical seal failure on pump shafts in water systems.

The literature relates abrasive action to the longevity of the seal, and describes the importance of proper alignment of the pump and drive shaft to the life expectancy of the seal. Results of exhaustive tests, the bulletin reports, show that the chemical content of treated circulating water has no adverse effects on the seal.

Water Knives

1225

Chain Belt Company, Milwaukee, Wis,. has published a new, 12-page bulletin describing the Rex water knife which may be used for any type of washing, cleaning, descaling and cooling operation. This device was formerly marketed by the company as "flat spray nozzles".

The bulletin contains new water knife selection data, complete specifications, and application information for various users. Its selection procedure is presented in simplified, outline form and is color-coded to make application selection easier.

Fuel Bulletins

1226

Enterprise Engine and Machinery Co., San Francisco, Calif., has announced the publication of two new bulletins which discuss the use of fuels in the company's fuel systems.

A 4-page folder, entitled "Dual Fuel", presents a concise explanation of the "dual fuel" systems which permits an Enterprise diesel engine to burn gaseous fuels, including natural gas and sewage, as well as diesel oil.

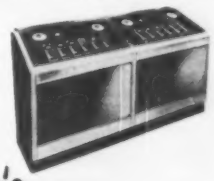
Also released is a 6-page bulletin called, "The Efficient Use of Heavy Fuels with Enterprise Engines". This bulletin presents an illustrated description of a typical Enterprise engine heavy fuel system, defines heavy fuels and explains how they are used in the company's diesel engines.

Rotary Distributors

1227

Process Engineers, Inc., Division of The Eimco Corporation, San Mateo, Calif., have recently released a 16-page bulletin describing Eimco-Process rotary distributors. These are self-propelled mechanisms designed to provide uniform distribu-

CONTINUED ON PAGE 104A



Here's Water Plant Control You Can Depend Upon!

This complete pneumatic system includes all the essential elements for the operation of water treatment plants. It is used for raw water flow control, flow measurement, chemical proportioning, level control and control of gravity filter operation.

Reliable mechanisms produce controlled air pressure for actuating meters, feeders and controllers and for measuring flow, head loss or water level.

The simplicity of this design offers you important plus values. Measurements are accurate and instantaneous. Operation is dependable. Maintenance is simple. *Write for Bulletin 1100.*

C.-A.-P. SYSTEM®
INSTRUMENTS

INFILCO

INFILCO Incorporated, General Offices—Tucson, Arizona
Field offices throughout the United States and other countries.

911

New Bulletins

CONTINUED FROM PAGE 103A

tion of sewage or organic industrial wastes over the surface of a biological filter.

Both standard rate and high rate types are described, and details are given on the variety of center assembly, arm and special-feature components used in the design of a complete machine.

The bulletin is liberally illustrated with engineering drawings, installation photographs and charts, and features single-stage and two-stage complete treatment flow sheets.

Recording Instruments

1228

General Electric Company, Schenectady, N. Y., is offering a new 12-page bulletin listing the complete specifications for the proper selection of General Electric recorders.

The new bulletin provides purchasing information covering the complete line of recording instruments, including dimensions and chart speeds, operating specifications, applications, features and accessories.

The various recorders are grouped by accuracy class for convenient selection, and photographs of all models discussed are included. The bulletin also describes specialized recording instruments available, such as spectrophotometers, recording vibrometers automatic oscillographs, self-balancing potentiometers, and speed recording systems.

Motor Control Digest

1229

Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has recently issued a new, 162-page digest containing descriptive, pricing, technical and engineering information covering its complete line of motor controls.

A quick-reference selector guide at the front of the digest makes it easy to find where any starter, controller or pilot device is listed. This condensed version of the Allis-Chalmers electrical control price book, its pages numbered in large bold type for easy reading, is cross-referenced with the price book numbers at the bottom of each page.

Unibase Turbine Pump Motors

1230

U.S. Electrical Motors, Inc., Los Angeles, Calif., has announced the publication of a full-colored brochure describing their new Unibase turbine pump motors furnished with the U.S. Microset coupling.

A cross-section of this new motor, characterized as the "first vertical pump motor designed for short-coupled industrial pumping service", is featured in the brochure. Other items include a complete discussion of the motor's various design features, and a detailed description of the exclusive Microset coupling which permits adjustment of the pump impellers without requiring pump shaft disassembly.

Submersible Pump

1231

Kenco Pump Division, American Crucible Products Co., Lorain, Ohio, is offering its new 10-page, fully illustrated catalog featuring 32 leading and indexed applications for submersible pumps.

To assist both the user and the specification writer of submersible pumps, the catalog lists the physical dimensions, pumping capacities, electrical data and specific features of each model, and includes Engineer's Specification Forms as handy guides for specifying the proper model required.

For added convenience, the complete directory of Kenco factory-trained service centers is included with a copy of its Exchange Pump Plan and service policy.

Filter Plant Control System

1232

Infilco, Inc., Tucson, Ariz., has announced the publication of a bulletin describing its new "C.-A.-P. System" for the automatic operation and control of filter plants operating on 3 to 15 psi output pressures.

Other information included in the bulletin are descriptions of integrated components for opening, closing and modulating valves, regulating chemical feed rates, and indicating and recording flow rates, levels and pressures.

Butterfly Valves

1233

Continental Equipment Company, Division of Fisher Governor Company, Coraopolis, Pa., has just released a new, four-page bulletin describing their complete line of butterfly valves.

Eight valve designs are presented in tabular form which makes comparison and selection easy. Valve sizes range from 1" to 108", with pressure drops up to 1200 psi and temperatures up to 2000°F. A list of accessories is also included in the bulletin.

Solving Tunnel Concreting Problems

1234

The Master Builders Company, Division of American-Marietta Co., Cleveland, Ohio, have recently published a 28-page bulletin describing the case histories of twelve major tunneling projects where their product was used to help solve concreting problems.

The bulletin contains many photographs taken on-the-job locations and discusses construction methods and techniques in detail.

Compact Proportioning Pump For Boiler Treatment Chemicals

1235

B-I-F Industries, Inc., Providence, R. I., announce release of a bulletin which describes their new, plunger-type, small capacity proportioning pump for operation with small, low pressure boilers.

Engineering and dimensional data, description of the pump's features, a photograph of the pump, and a list of the boiler water treatment handled are all included in this 2-page bulletin.

Corrosion-Resistant Saturator

1236

B-I-F Industries, Inc., Providence, R. I., have recently issued a new bulletin describing a re-designed, completely corrosion-resistant saturator which automatically prepares a stock solution of sodium fluoride for treating water supplies.

The 2-page bulletin contains descriptive information on the new style saturator, a cutaway drawing of the unit showing internal parts, and a typical installation drawing for the

fluoridation of drinking water. Among the features discussed in the bulletin is the translucence of the saturator's tank which enables the operator to determine the fluoride level at a glance.

Municipal Water Tank 1237

Graver Tank and Mfg. Co., East Chicago, Ind., has released a new bulletin describing the Aquatore elevated water tank designed to be esthetically compatible with the particular environment in which it is erected.

Illustrated with photographs, dimensional drawings and a chart, the bulletin presents a comparison of the new type tank with the conventional design and briefly discusses water storage facilities in general.

Digester Circulation-Mixer 1238

Walker Process Equipment, Inc., Aurora, Ill., has published a new issue of bulletin 25-S-91 which describes their Gaslifter unit for digester circulation-mixing. This eight page, second edition has numerous photographs showing equipment installations, and includes a detailed, illustrated description of the unit in operation.

Another feature of the bulletin is a complete list of the specifications needed when ordering the equipment. Among the advantages of the Gaslifter is its suitability for installation in all types of digester covers.

Buyers Guide To Industrial Valves 1239

Ohio Injector Company, Wadsworth, Ohio, has recently published a 24-page booklet called, "Buyers Guide", which provides a convenient method for the quick selection of valves by valve specifiers, users and purchasers.

The booklet features a cross-index of the complete OIC line with the valves of sixteen major manufacturers, and includes a list of frequently used abbreviations, a valve trim chart, a list of valves conforming to Federal specifications, and complete figure number descriptions.

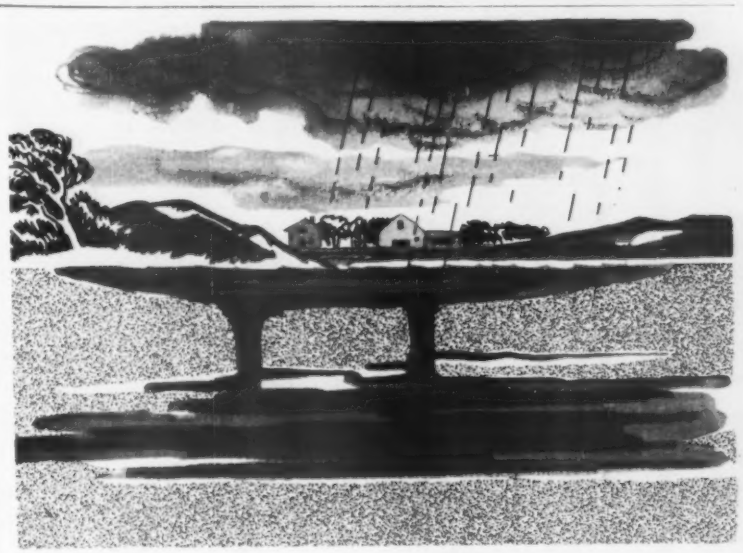
A breakdown of the OIC product line by valve material and pressure class, and classification by type, disc design, seating arrangement, stem operation, bonnet, and end connection serves as an additional guide to valve selection.

Movie Explains Factory-Built Lift Stations 1240

Smith and Loveless, Inc., Lenexa, Kansas, have announced the availability of their first motion picture which describes the construction and operation of the company's factory-built sewage lift stations. The film may be shown on Cinesalesman continuous projectors which do not require rewinding or re-threading at the conclusion of each showing, and which run the movie without break in full color, sound projection.

The movie was filmed entirely by Smith and Loveless personnel, with technical services provided by the Calvin Co., of Kansas City, a major 16mm film laboratory. One of the film's features is a tour of the manufacturer's plant showing how the sewage lift stations are built. Both standard process photography and animation techniques were used to make the movie.

CONTINUED ON PAGE 106A



UP-SIDE-DOWN WATER WELLS

There is comfort in the knowledge that today's engineers and water works men are craftsmen thoroughly familiar with the water problem and its remedy.

Extensive experiments are being made to control drought by producing artificial rainfall. "Upside-down wells" are used in some areas with declining water tables, run-off surface water during peak rainfall being injected into the ground through wells. Waste of water through evaporation in some dry areas is as much as eight feet of water per year from reservoir surfaces. Recent experiments in spreading a thin coat of cetyl alcohol on a water reservoir surface reduced evaporation as much as 65%. Considerable progress is being made in research and experiments designed to remove salt from seawater.

It is no longer true that "much water goeth by the mill which the miller knoweth not of." Water works men know the facts of life so far as water is concerned, but they need public support.

This series is an attempt to put into words some appreciation of the water works men of the United States.

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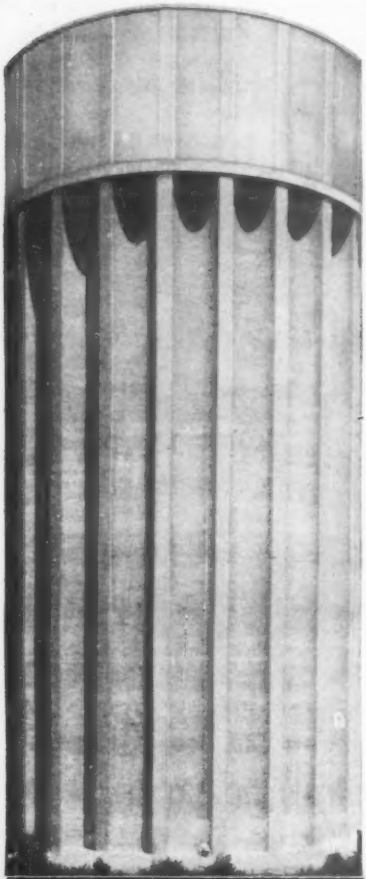

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New Bulletins

CONTINUED FROM PAGE 105A

Audio Tone System

1241

Femco, Inc., Irwin, Pa., has recently issued its Bulletin 5906 which describes and illustrates a simple, convenient method of telemetering, monitoring, indicating and controlling equipment by using the Femco Audio Tone systems.

Especially advantageous where audio tones can be transmitted over leased telephone lines, the systems also make it possible for many frequencies to be transmitted over the same pair of wires by utilizing a separate oscillator for each tone. Filters at the receiving end pick out only the frequency signal for which each is designed.

Combination systems, using audio tone (AC) for telemetering and DC for indication and control, are possible by incorporating the Femco Circuit Scanner. This is described in their Bulletin 5905.

Scientific And Test Instruments

1242

Minneapolis-Honeywell Regulator Co., St. Paul, Minn., has issued a new, condensed catalog which presents a brief description, prime specifications, an illustration and an additional information reference for each series of its scientific and test instruments.

Items in the 48-page catalog include D-C amplifiers, data handling systems, laboratory and calibrating instruments, magnetic tape instrumentation, nuclear instrumentation, oscillographs, recorders and indicators, servo components, temperature controllers, and transducers.

Chemical Proportioning Pump

1243

B-I-F Industries, Inc., Providence, R. I., has just released a new bulletin describing its new, electrically driven, positive displacement chemical proportioning pump designed for the accuracy proportioning of acids, alkalies, and other chemical solutions used to process water in industry.

Features described are: a corrosion-resistant transparent head; Hypalon diaphragm and check valves, and a straight-through flow design. Its versatility makes it ideal for the water treatment field, for industry, swimming pools, chemical plants, municipalities; wherever precise feeding of chemicals is especially important.

The two page bulletin contains photographs of the Simplex, Duplex and Triplex models for proportioning up to 11, 22, 33 gallons per hour against discharge pressures up to 125 per square inch. Also included are typical installation diagrams, a description of the 1/6 H.P. feeder and its operation, a feeder capacity chart, and a partial list of the many chemical solutions handled by the Chem-O-Feeder.

Bio-Oxidation Aerator

1244

Permutit Company, Division of Pfaudler Permutit, Inc., New York, N. Y., has published a six page bulletin describing the advantages of using the Permutit Permaerator in aeration systems. The bulletin contains diagrams and charts which illustrate the various design features and how the equipment operates.

According to the bulletin the Permaerator is a mechanical-turbine aerator developed primarily for use in the activated sludge process. By utilizing the interaction of two impellers on the air bubbles, it sets a new high rate of oxygen transfer in relation to the horsepower of the unit's motor.

It is easily installed in existing basins as well as new systems.

DARLEY MAGNETIC DIPPING NEEDLE
$17.50

with 3 section telescoping handle
$22.25

Write Today for 100-Page Catalog

W. S. DARLEY & CO., Chicago 12

High-Capacity Electric Generators

1245

D. W. Onan & Sons, Minneapolis, Minn., recently released their new 1960 general catalogue which features the recently added line of high-capacity electric generating plants.

The catalogue is an attractive 8-page folder listing more than 45 basic models on Onan gasoline and Diesel engine-driven generator sets. Each series of generating plant types is described in detail, and specifications for both engine and generator are given making it comparatively simple for the reader to select the proper plant for his particular needs.

A chart of representative models for each specific series lists such items as plant capacity, model number, voltage, starting method, dimensions and weight.

Presented for the first time in a catalogue, are Onan's new high-capacity, gasoline and Diesel engine-driven plants. Ranging up to 170,000 watts (gasoline) and 230,000 watts (Diesel, these new plants are highly recommended for dependable standby service.

Optional accessories for each series of generating plants are also illustrated.

Spray-Type Deaerator Heaters

1246

Graver Water Conditioning Company, New York, N. Y., has made available a revised and enlarged bulletin on spray type dearating heaters. Bulletin, WC-101C, explains many aspects of the process and equipment, including principles of dearation, dearator operation, standard designs available, design features and accessory equipment.

The bulletin contains many photographs of installed equipment and other illustrations.

Lining Protects Steel & Concrete Tanks

1247

Amercoat Corporation, South Gate, Calif., has issued a new, six page, illustrated brochure describing Amer-Plate industrial lining. This is a dense, flexible polyvinyl chloride sheet used to line plating, pickling and other process tanks and vessels.

N-Sol SETTLES YOUR COAGULANT PROBLEMS FAST!

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Bureau Water and Sewers

The City of Batavia, New York is accepting applications for the position of Superintendent, Bureau of Water and Sewers. Will have charge of water filtration plant, water distribution operations and sewage disposal system. Desired qualifications include college degree in sanitary or civil engineering with experience in sanitary operations preferred. Eligibility for Professional Engineers license preferred but not required. Salary range $6408 to $7302. Send resume and application to City Administrator, City Hall, Batavia, New York.

Positions Available for

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These men must be graduated Civil or Sanitary Engineers, with experience in heavy construction, sewer lines, sewerage treatment plants and reenforced concrete.

These positions are with a Venezuelan Construction Company that will construct a Sewerage Scheme on the Island of Trinidad, British West Indies.

Excellent salaries. Minimum length of construction time is three years. Send resume including salary requirements to: Apartado del Este: No. 5281, Caracas, Venezuela.

WATER UTILITY MANAGER—Exceptional opportunity for man with experience in water utility operation. College degree and administrative ability essential. Will be responsible for all operations in his district, reporting to Vice President. Location—Chicago area. Send complete resume of experience to Box 6080.

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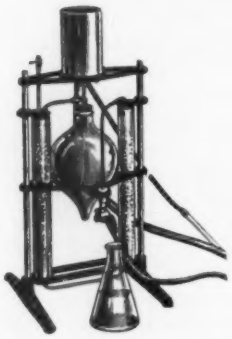

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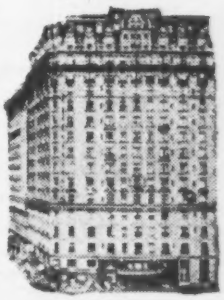

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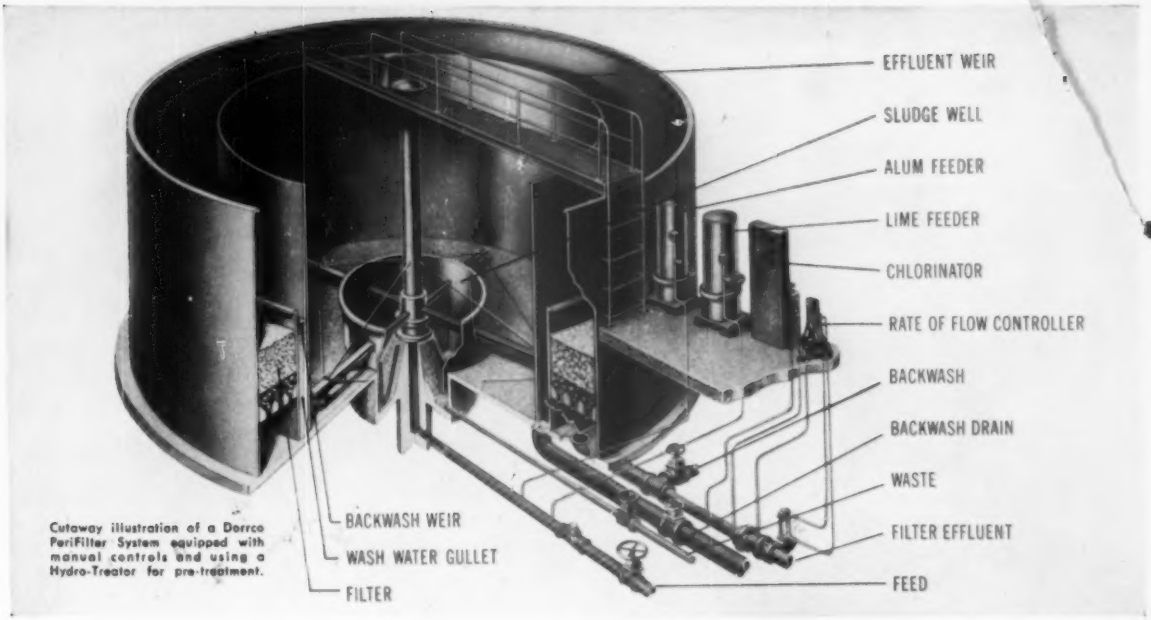

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